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Watanabe

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(45) **Date of Patent:** **Jul. 21, 2015**

(54) **IMAGE FORMING APPARATUS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(22) Filed: **Jan. 22, 2014**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Jun. 20, 2013 (JP) 2013-129629

(51) **Int. Cl.**
G03G 15/01 (2006.01)
G03G 15/16 (2006.01)
G03G 13/16 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 13/16*** (2013.01); ***G03G 15/161*** (2013.01); ***G03G 15/1675*** (2013.01); *G03G 15/0136* (2013.01); *G03G 2215/1661* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/161; G03G 2215/1661
USPC 399/66, 71
See application file for complete search history.

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JP	A-2002-72713	3/2002
JP	A-2002-214932	7/2002
JP	A-2005-156776	6/2005

* cited by examiner

Primary Examiner — Gregory H Curran
(74) *Attorney, Agent, or Firm* — Oliff PLC

(57) **ABSTRACT**

An image forming apparatus includes image carriers that carry toner images; an intermediate transfer body that is brought into contact with the image carriers to carry the images before transferring them to a recording material; first transfer devices that include first transfer members and form first-transfer electric fields for transferring the images on the image carriers to the intermediate transfer body; a second transfer device that includes a second transfer member and forms a second-transfer electric field for transferring the images transferred to the intermediate transfer body to the recording material; and an adjusting device that adjusts an electric field to be formed in a second transfer area to a cleaning electric field, which is of the same polarity as and a lower intensity than the second-transfer electric field, when the images on the intermediate transfer body passes through the second transfer area without a recording material passing therethrough.

13 Claims, 23 Drawing Sheets

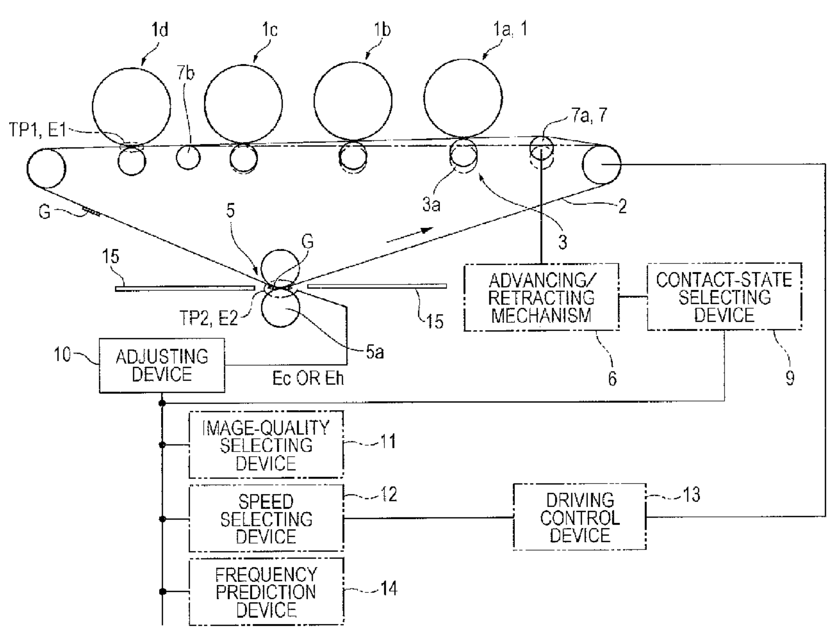


FIG. 1

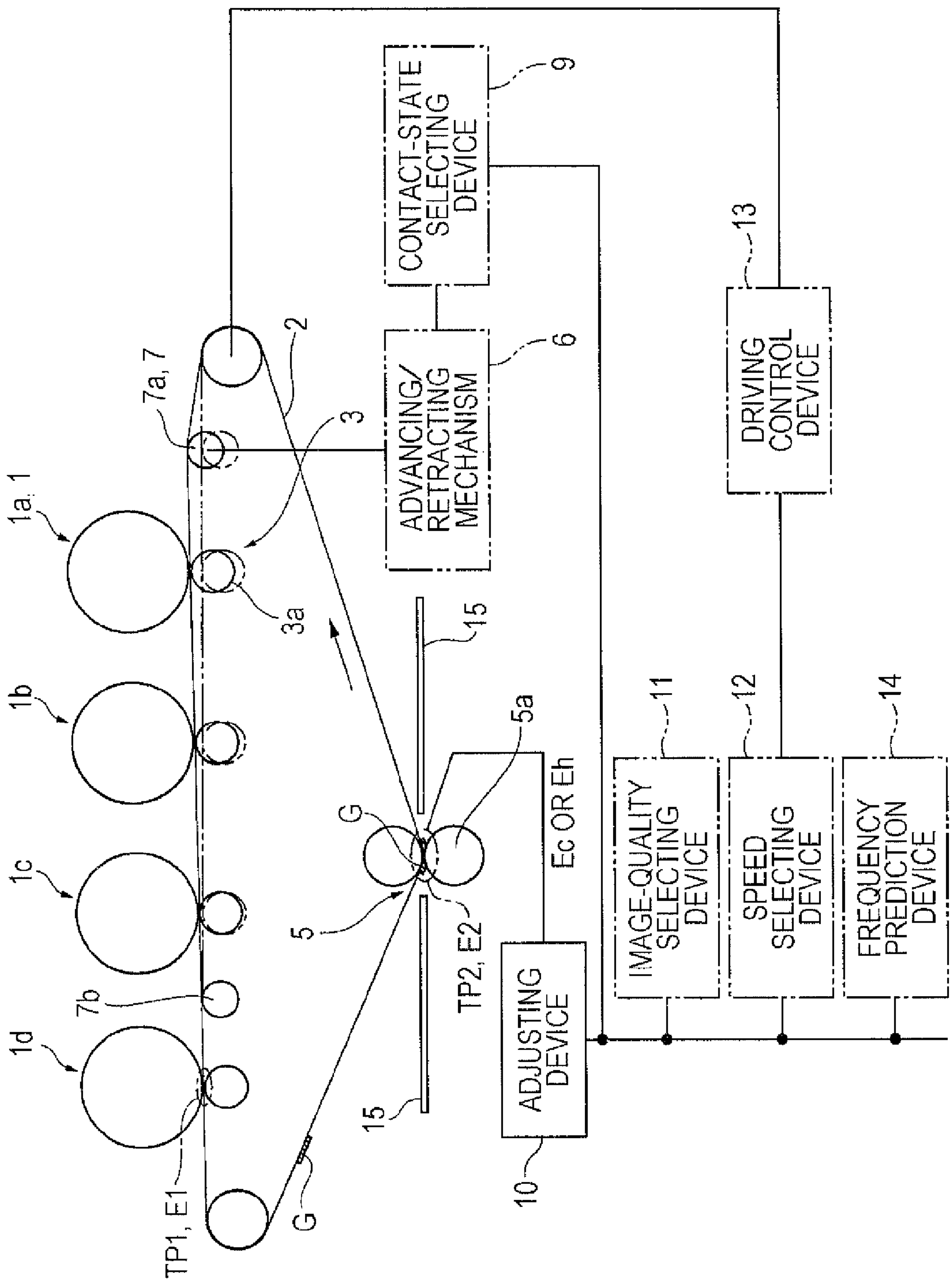

CONTACT-STATE SELECTING DEVICE
9
ADVANCING/ RETRACTING MECHANISM
6
DRIVING CONTROL DEVICE
13
ADJUSTING DEVICE
10
IMAGE-QUALITY SELECTING DEVICE
11
SPEED SELECTING DEVICE
12
FREQUENCY PREDICTION DEVICE
14
Ec OR Eh
1a, 1
1b
1c
1d
2
3
3a
5
5a
7a, 7
7b
15
G
TP1, E1
TP2, E2

FIG. 2

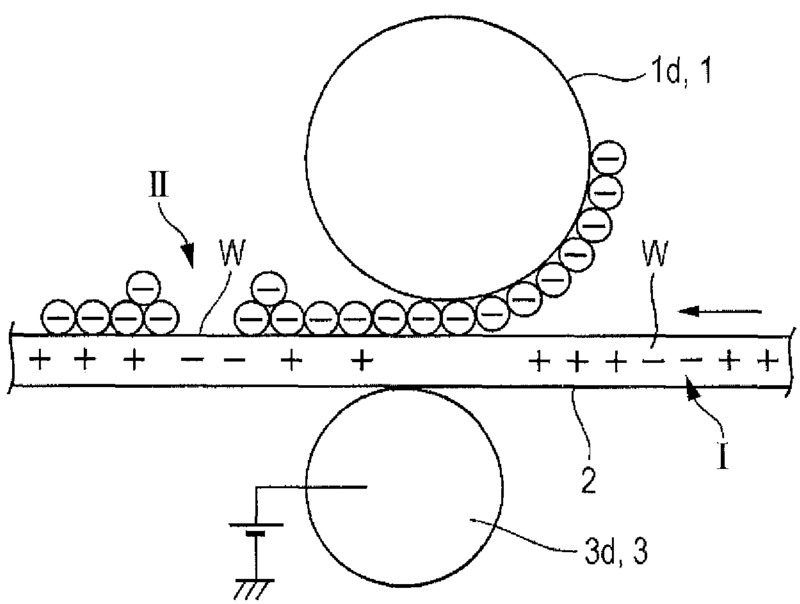
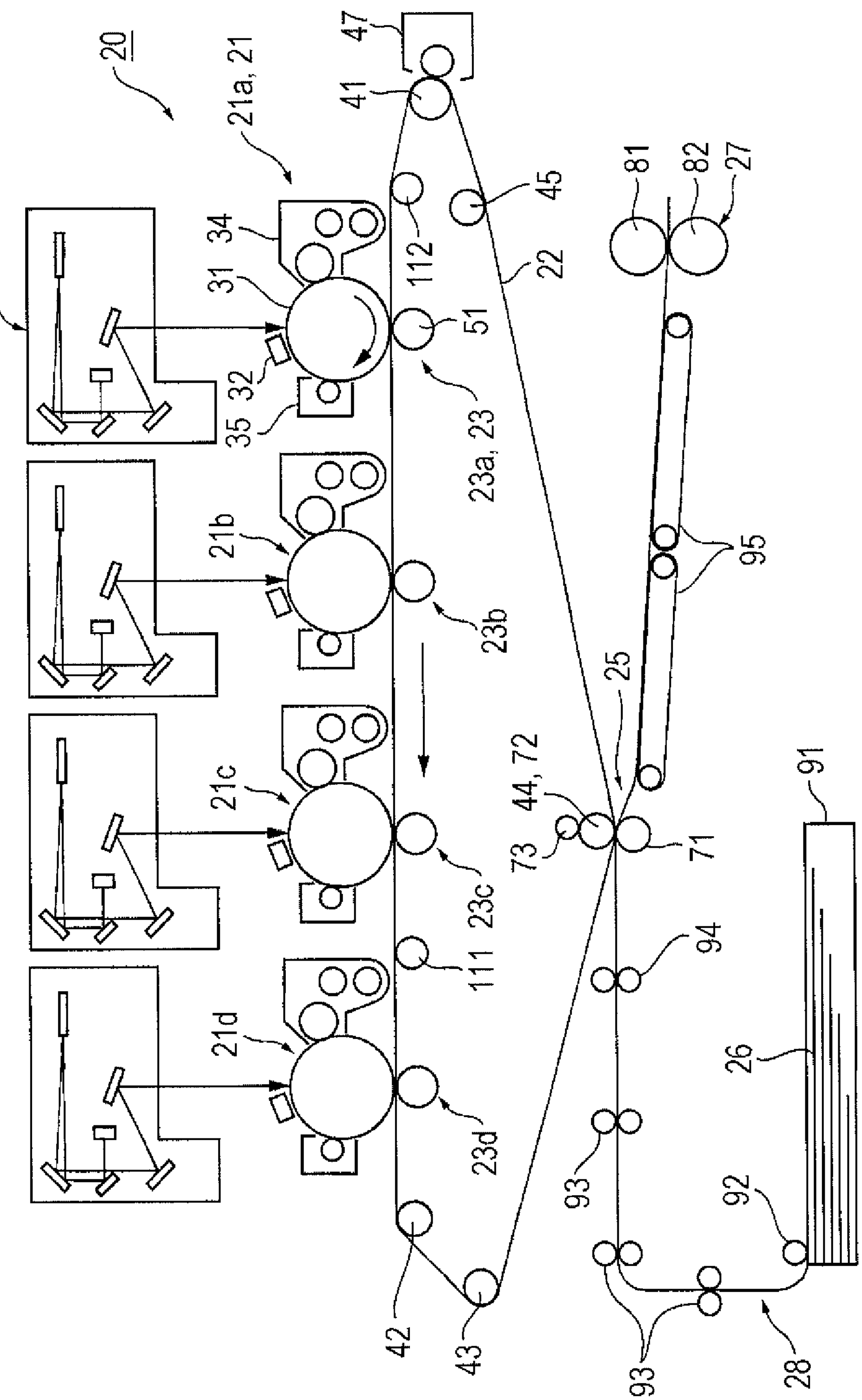


FIG. 3



20
21a, 21
47
41
33
34
31
112
45
22
81
82
27
32
51
35
23a, 23
21b
23b
95
25
21c
44, 72
73
71
23c
91
111
94
21d
26
23d
93
92
42
43
93
28

FIG. 4

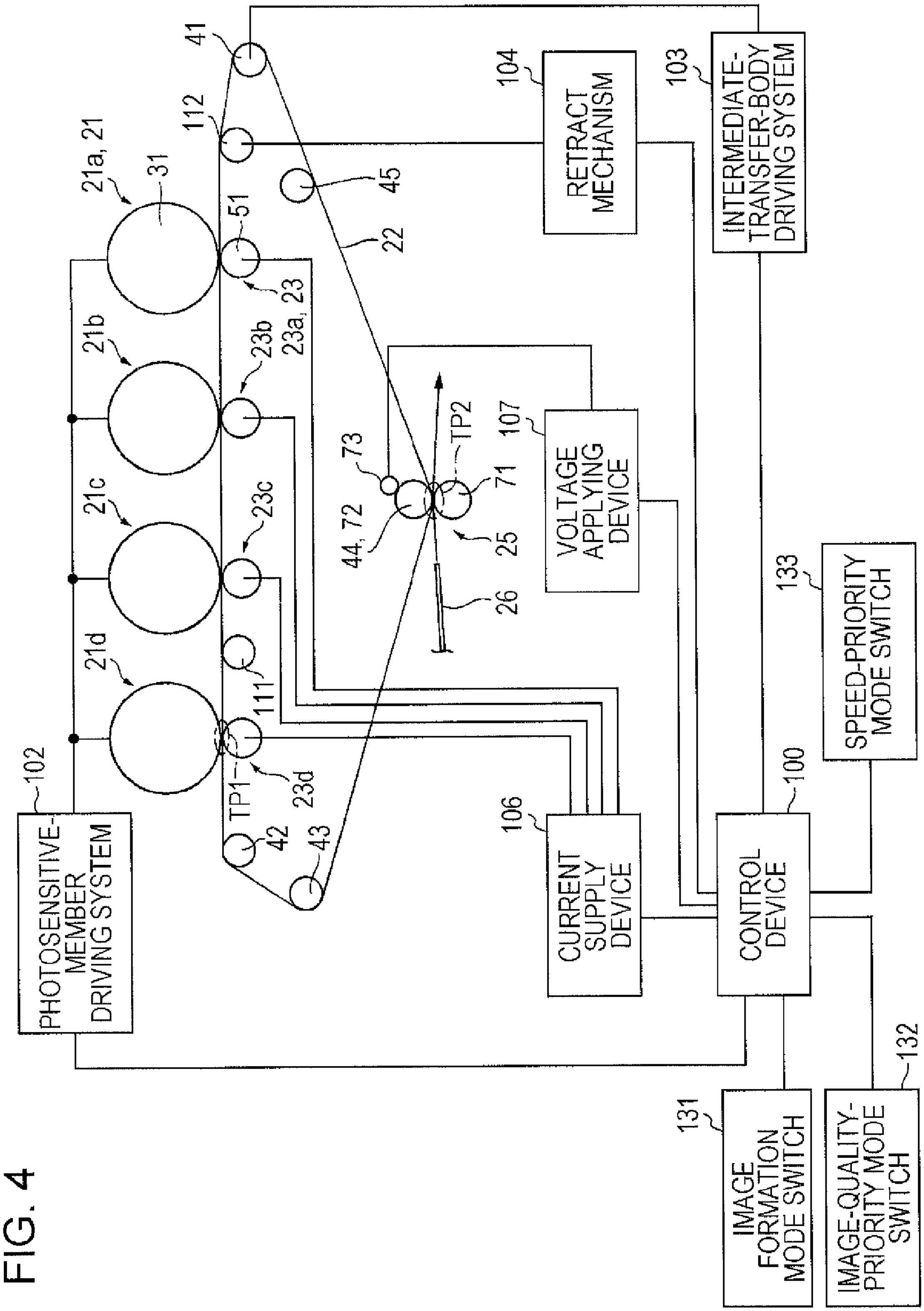

PHOTOSENSITIVE-MEMBER DRIVING SYSTEM
102
21d
21c
21b
21a, 21
31
TP1
23d
23c
23b
23a, 23
51
111
112
41
42
43
45
22
44, 72
73
71
TP2
25
26
106
CURRENT SUPPLY DEVICE
107
VOLTAGE APPLYING DEVICE
104
RETRACT MECHANISM
103
INTERMEDIATE-TRANSFER-BODY DRIVING SYSTEM
100
CONTROL DEVICE
133
SPEED-PRIORITY MODE SWITCH
131
IMAGE FORMATION MODE SWITCH
132
IMAGE-QUALITY-PRIORITY MODE SWITCH

FIG. 5A

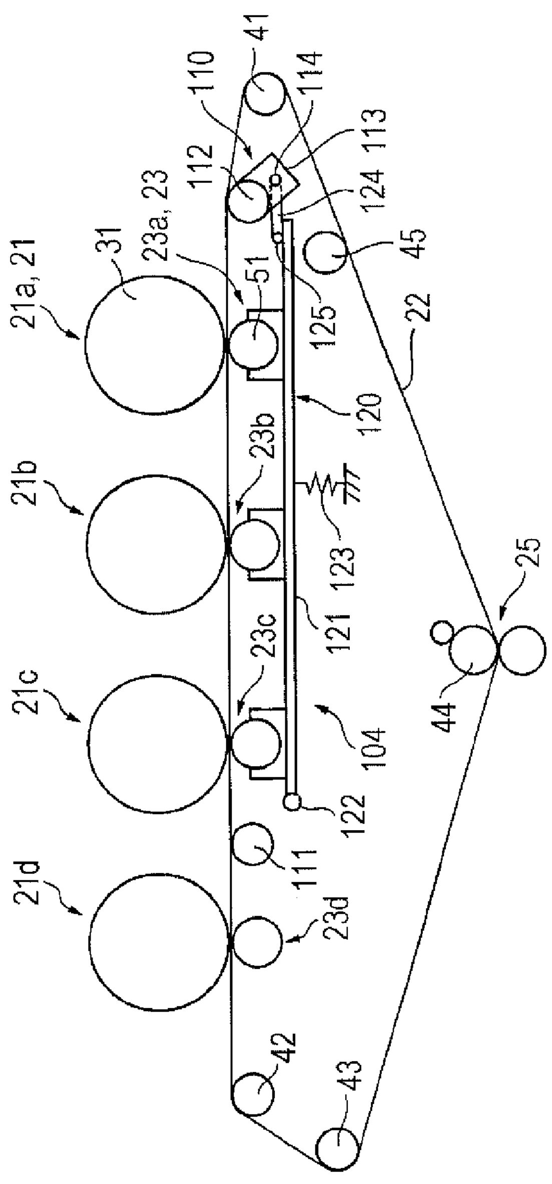

21a, 21
31
23a, 23
110
41
112
114
113
124
51
45
125
22
120
21b
23b
123
121
25
21c
23c
104
44
122
21d
111
23d
42
43

FIG. 5B

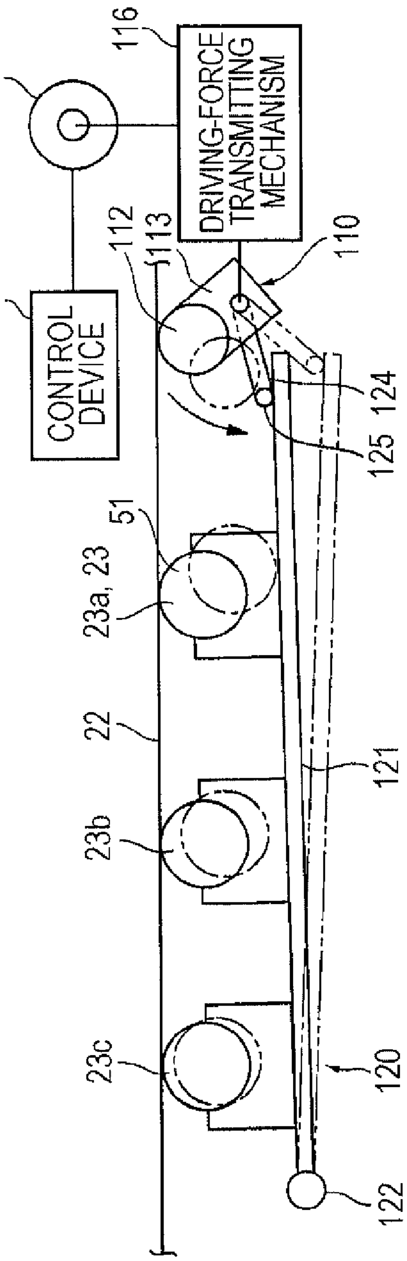

116
DRIVING-FORCE TRANSMITTING MECHANISM
115
100
CONTROL DEVICE
112
113
110
124
125
51
23a, 23
22
121
23b
23c
120
122

FIG. 6A

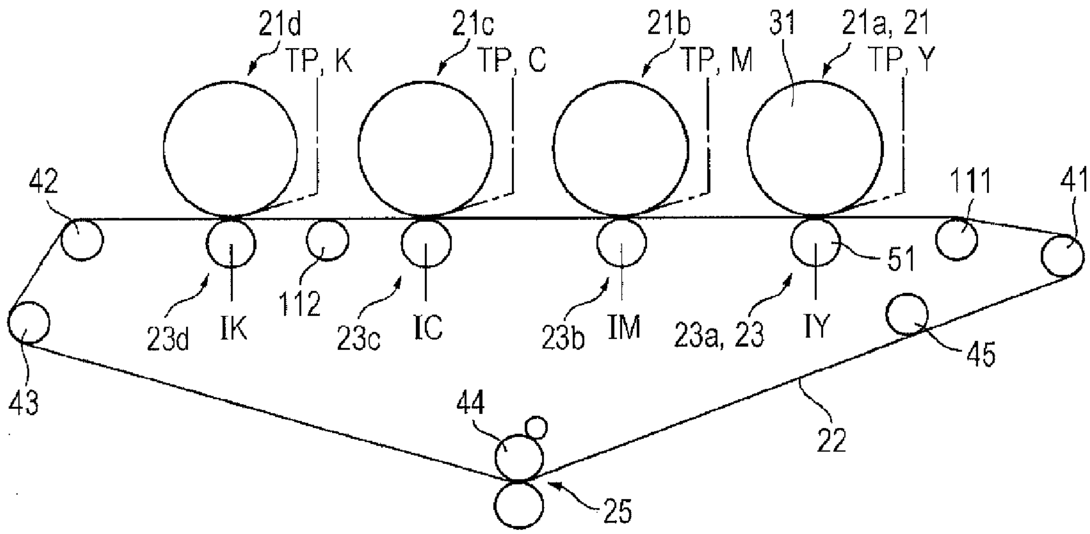

21d
TP, K
21c
TP, C
21b
TP, M
31
21a, 21
TP, Y
42
111
41
51
23d
IK
112
23c
IC
23b
IM
23a, 23
IY
45
43
44
22
25

FIG. 6B

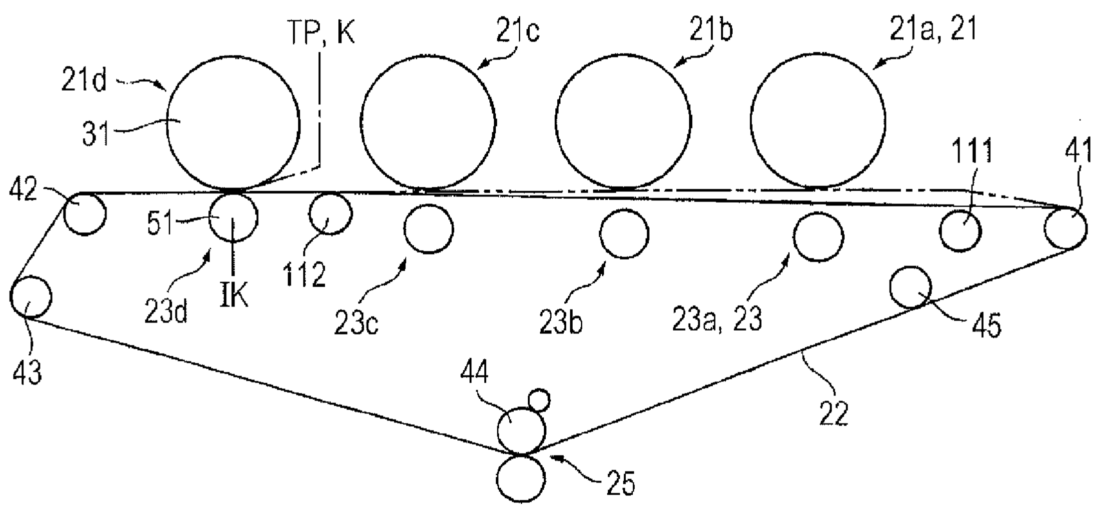

TP, K
21c
21b
21a, 21
21d
31
111
41
42
51
112
23d
IK
23c
23b
23a, 23
45
43
44
22
25

FIG. 7

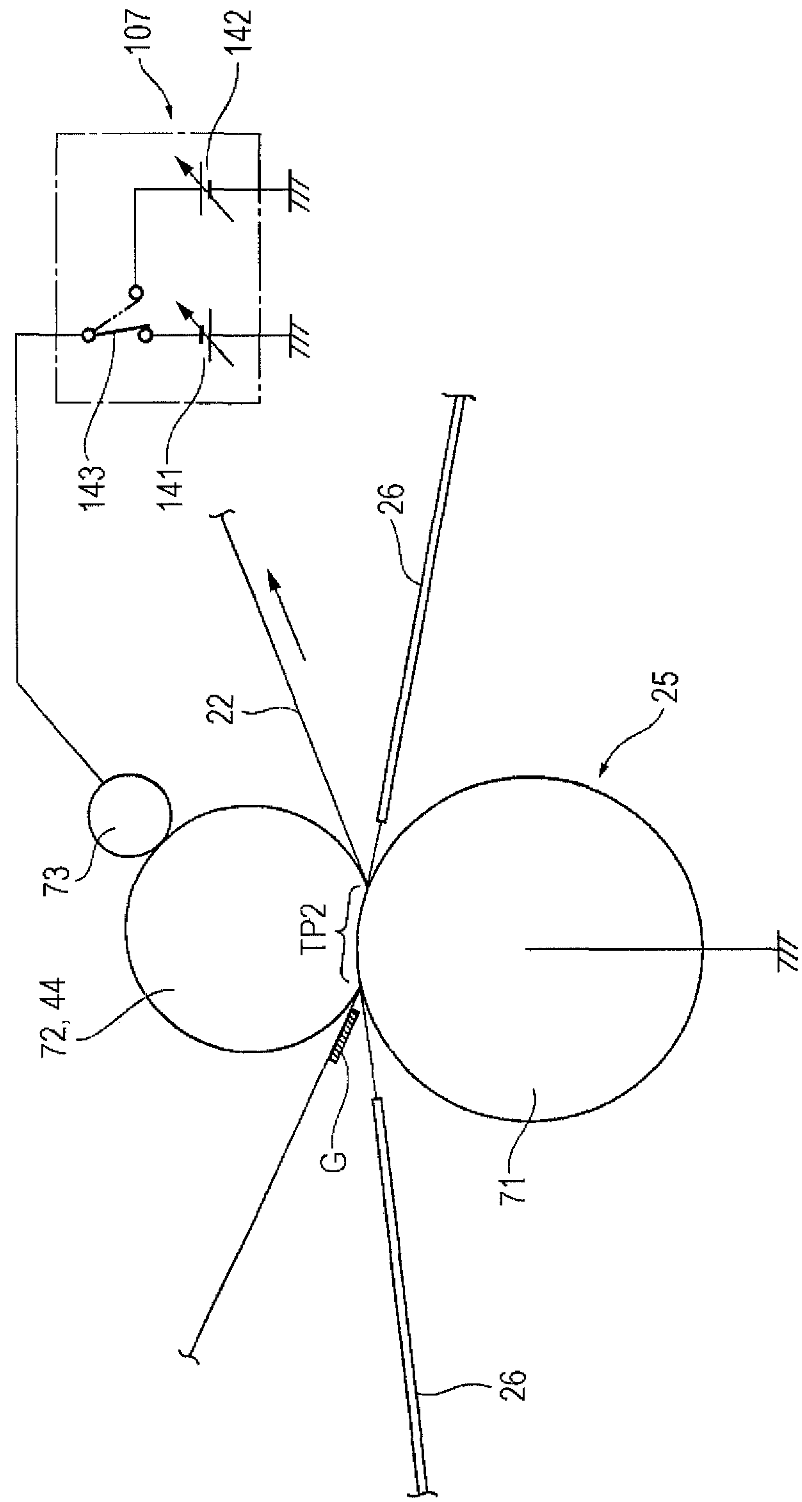


FIG. 8A

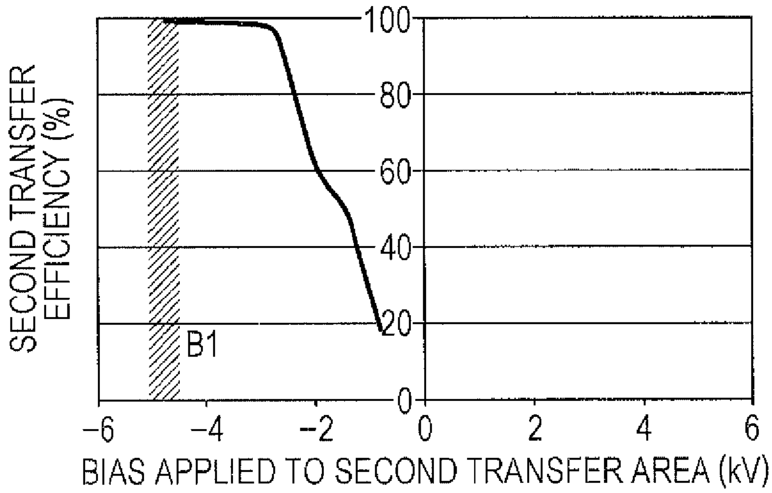


FIG. 8B

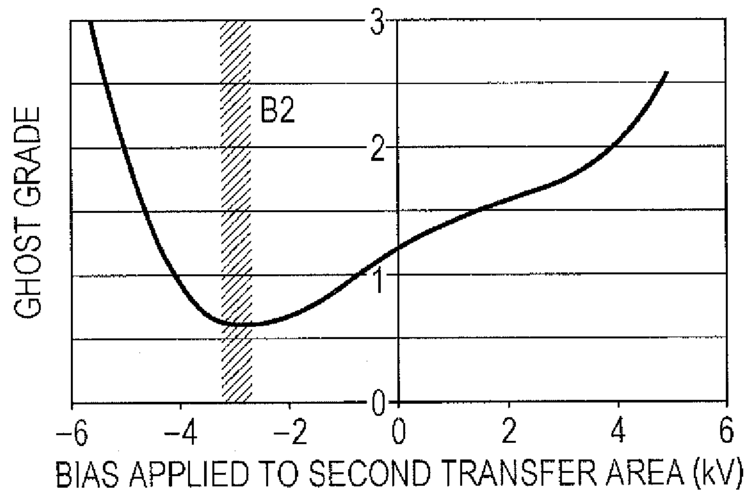


FIG. 8C

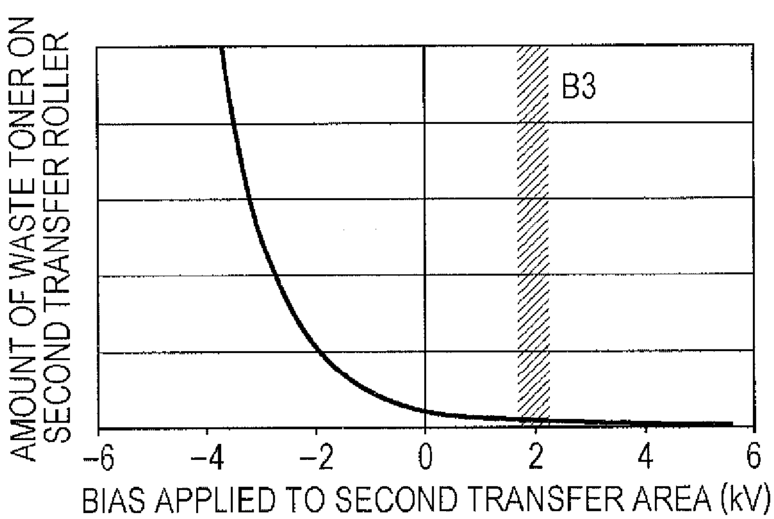


FIG. 9

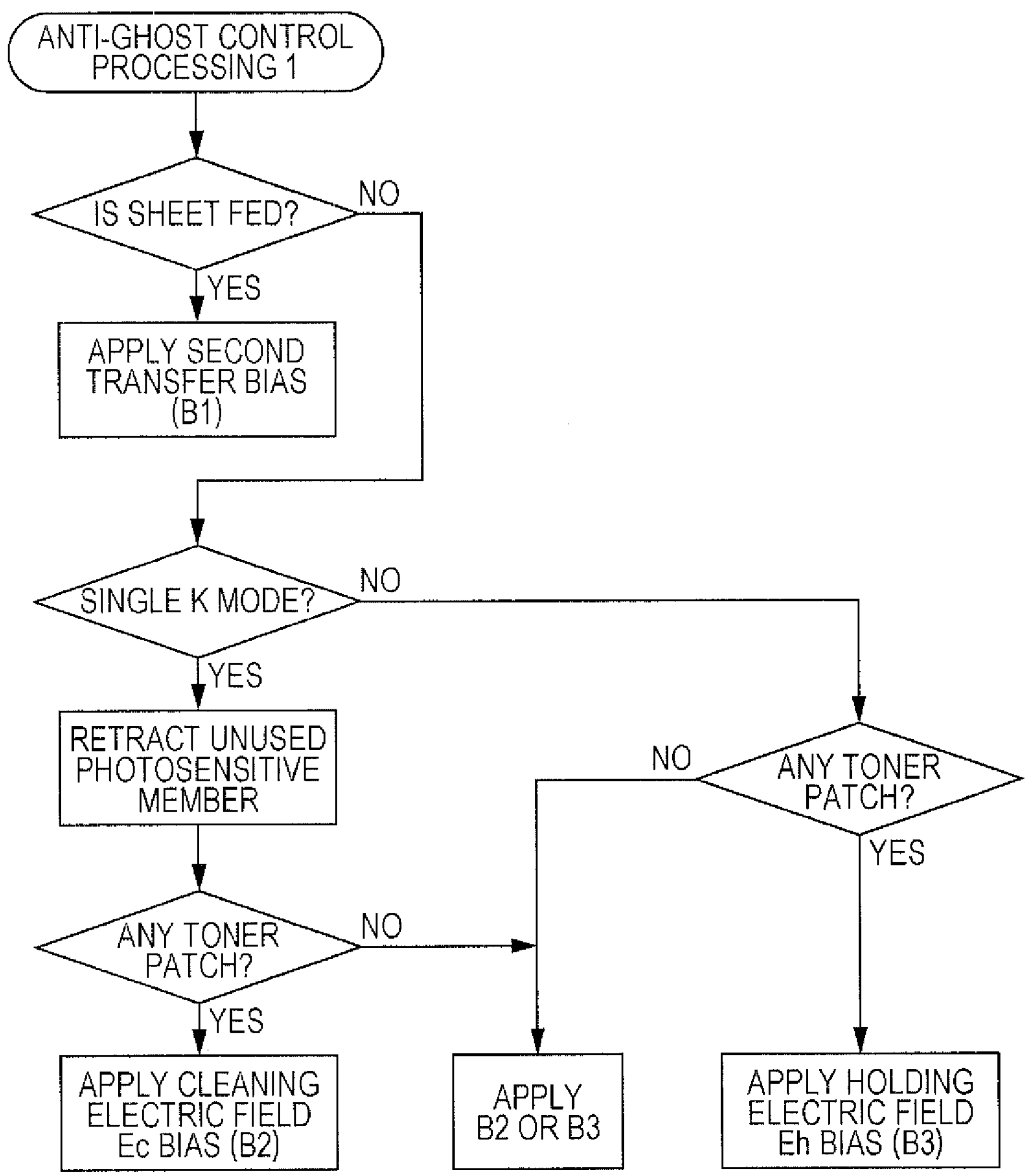

ANTI-GHOST CONTROL PROCESSING 1
IS SHEET FED?
NO
YES
APPLY SECOND TRANSFER BIAS (B1)
SINGLE K MODE?
NO
YES
RETRACT UNUSED PHOTOSENSITIVE MEMBER
ANY TONER PATCH?
NO
YES
ANY TONER PATCH?
NO
YES
APPLY CLEANING ELECTRIC FIELD Ec BIAS (B2)
APPLY B2 OR B3
APPLY HOLDING ELECTRIC FIELD Eh BIAS (B3)

FIG. 10A

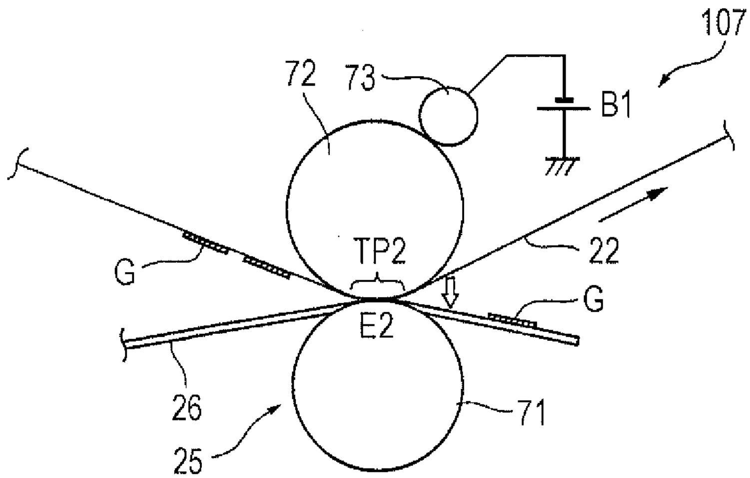


FIG. 10B

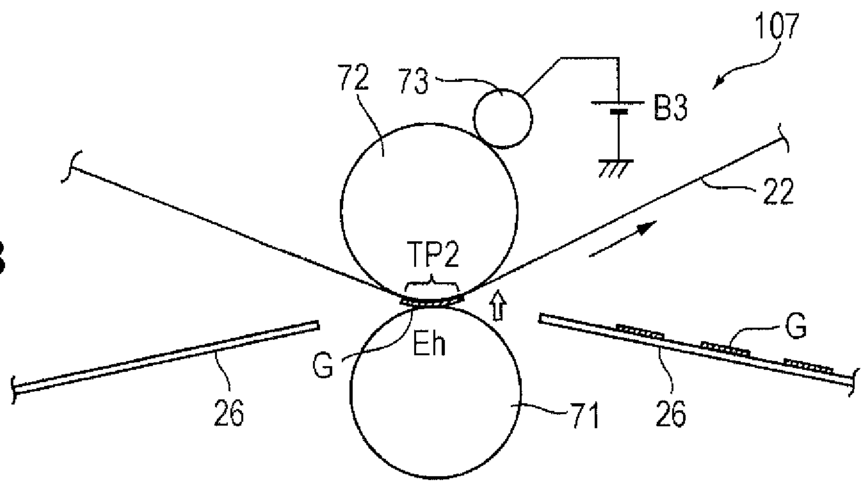


FIG. 10C

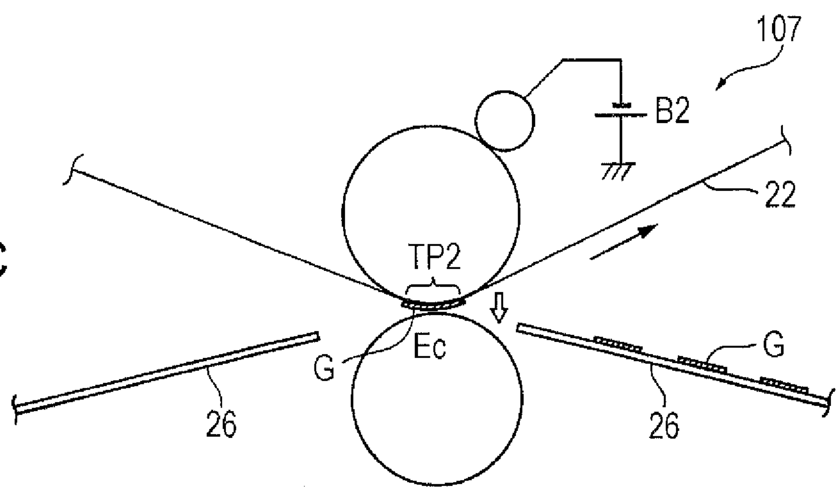


FIG. 11

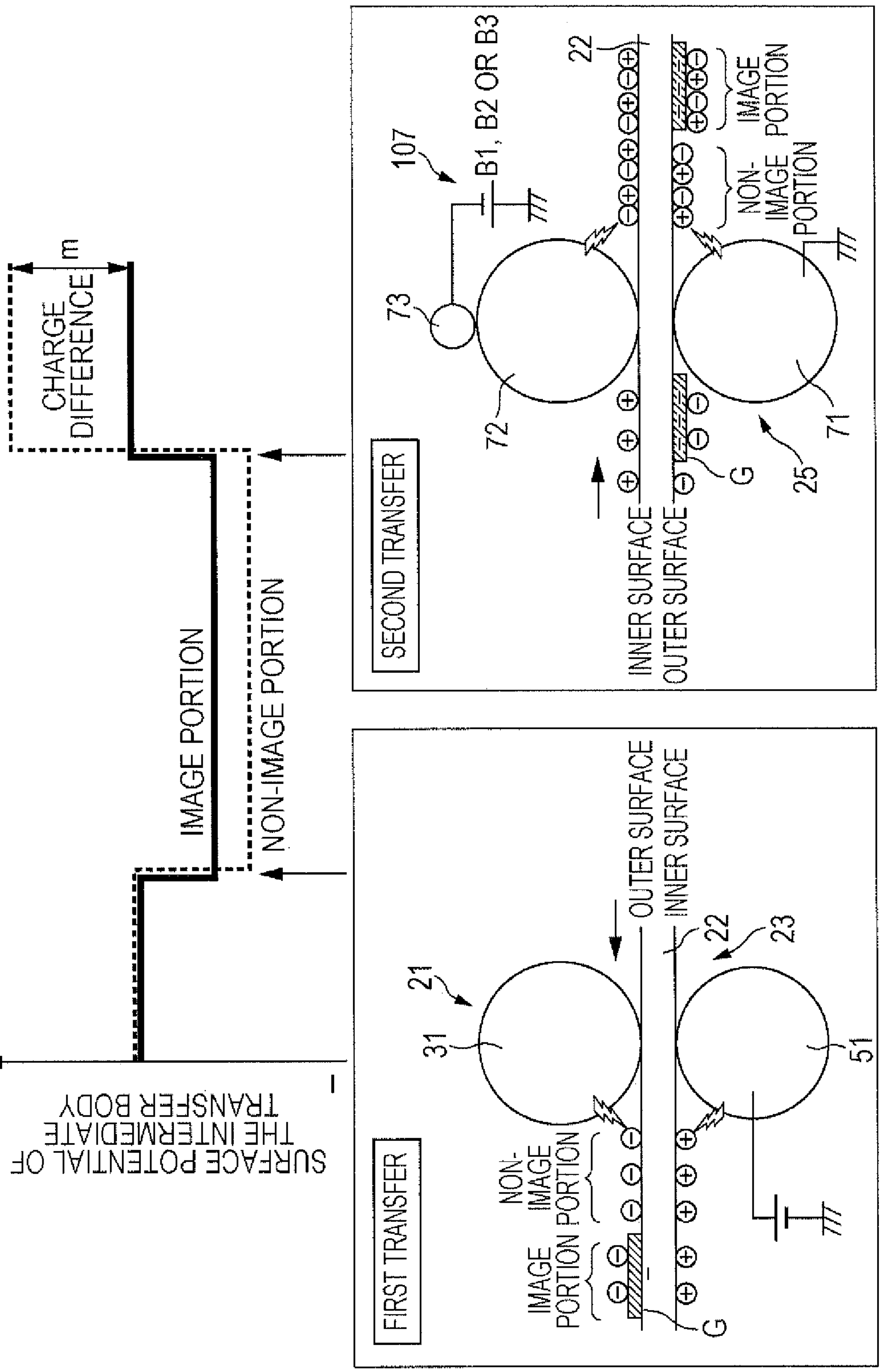

SURFACE POTENTIAL OF THE INTERMEDIATE TRANSFER BODY
+
−
IMAGE PORTION
NON-IMAGE PORTION
CHARGE DIFFERENCE
m
FIRST TRANSFER
IMAGE PORTION
NON-IMAGE PORTION
G
OUTER SURFACE
INNER SURFACE
21
31
22
23
51
SECOND TRANSFER
INNER SURFACE
OUTER SURFACE
G
25
71
72
73
107
B1, B2 OR B3
22
NON-IMAGE PORTION
IMAGE PORTION

FIG. 12

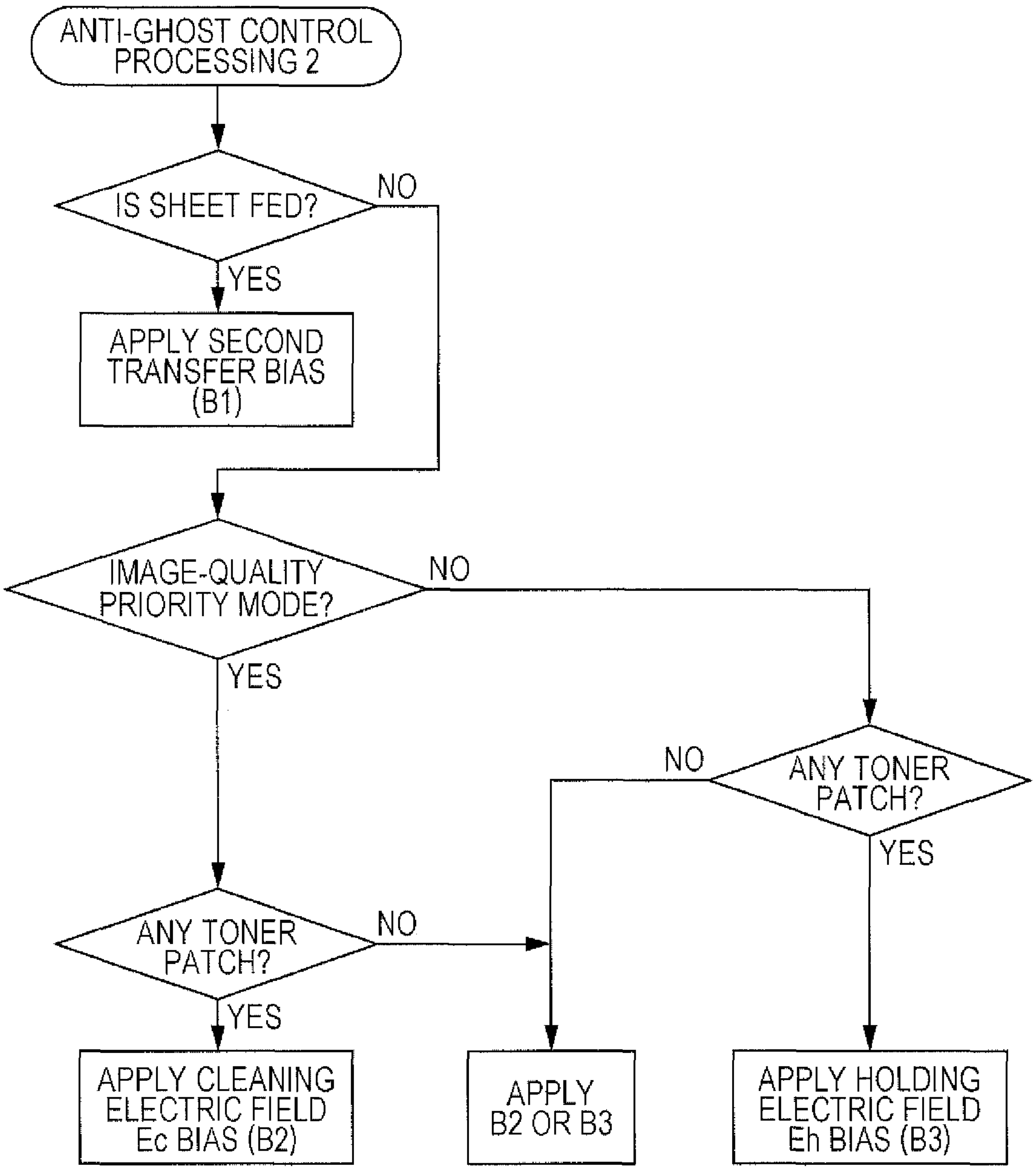

ANTI-GHOST CONTROL PROCESSING 2
IS SHEET FED?
NO
YES
APPLY SECOND TRANSFER BIAS (B1)
IMAGE-QUALITY PRIORITY MODE?
NO
YES
ANY TONER PATCH?
NO
YES
ANY TONER PATCH?
NO
YES
APPLY CLEANING ELECTRIC FIELD Ec BIAS (B2)
APPLY B2 OR B3
APPLY HOLDING ELECTRIC FIELD Eh BIAS (B3)

FIG. 13

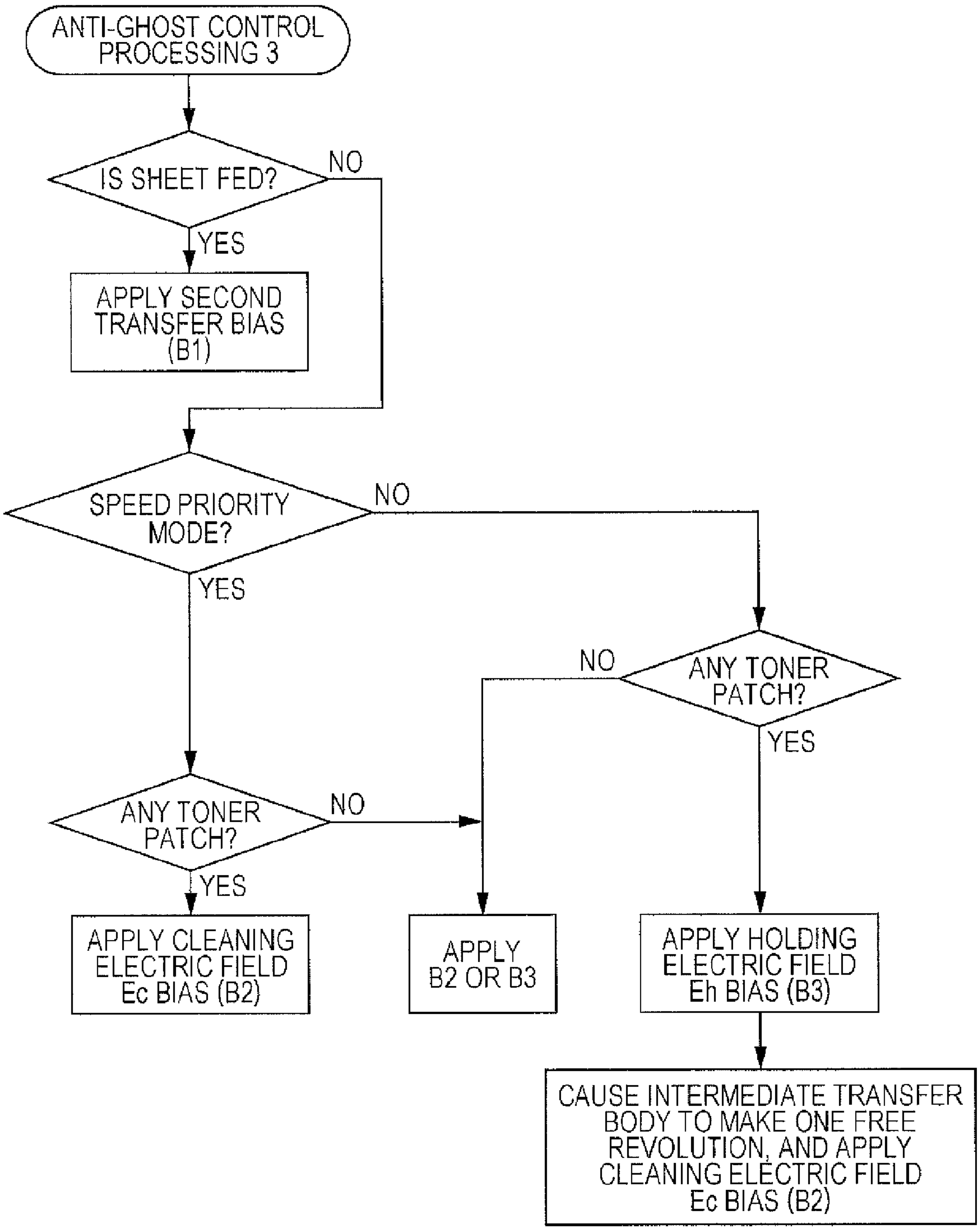

ANTI-GHOST CONTROL PROCESSING 3
IS SHEET FED?
NO
YES
APPLY SECOND TRANSFER BIAS (B1)
SPEED PRIORITY MODE?
NO
YES
ANY TONER PATCH?
NO
YES
ANY TONER PATCH?
NO
YES
APPLY CLEANING ELECTRIC FIELD Ec BIAS (B2)
APPLY B2 OR B3
APPLY HOLDING ELECTRIC FIELD Eh BIAS (B3)
CAUSE INTERMEDIATE TRANSFER BODY TO MAKE ONE FREE REVOLUTION, AND APPLY CLEANING ELECTRIC FIELD Ec BIAS (B2)

FIG. 14

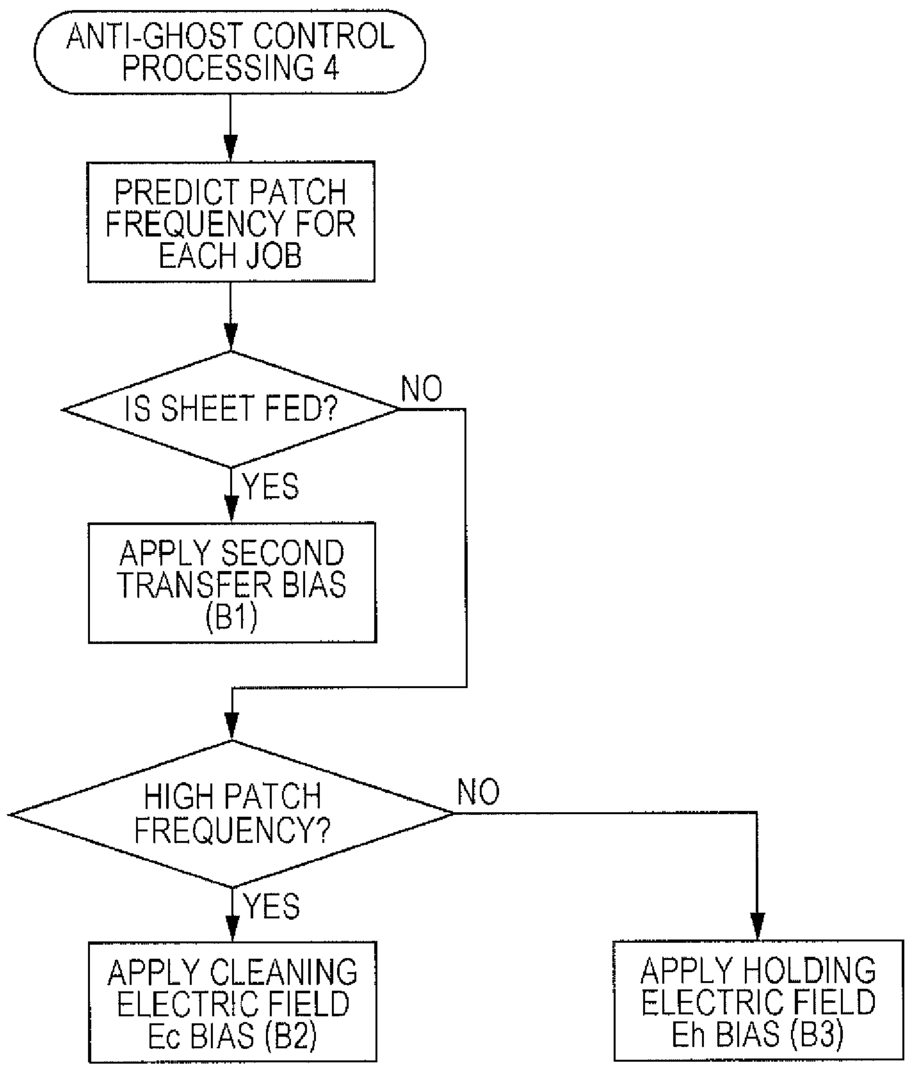

ANTI-GHOST CONTROL PROCESSING 4
PREDICT PATCH FREQUENCY FOR EACH JOB
IS SHEET FED?
NO
YES
APPLY SECOND TRANSFER BIAS (B1)
HIGH PATCH FREQUENCY?
NO
YES
APPLY CLEANING ELECTRIC FIELD Ec BIAS (B2)
APPLY HOLDING ELECTRIC FIELD Eh BIAS (B3)

FIG. 15

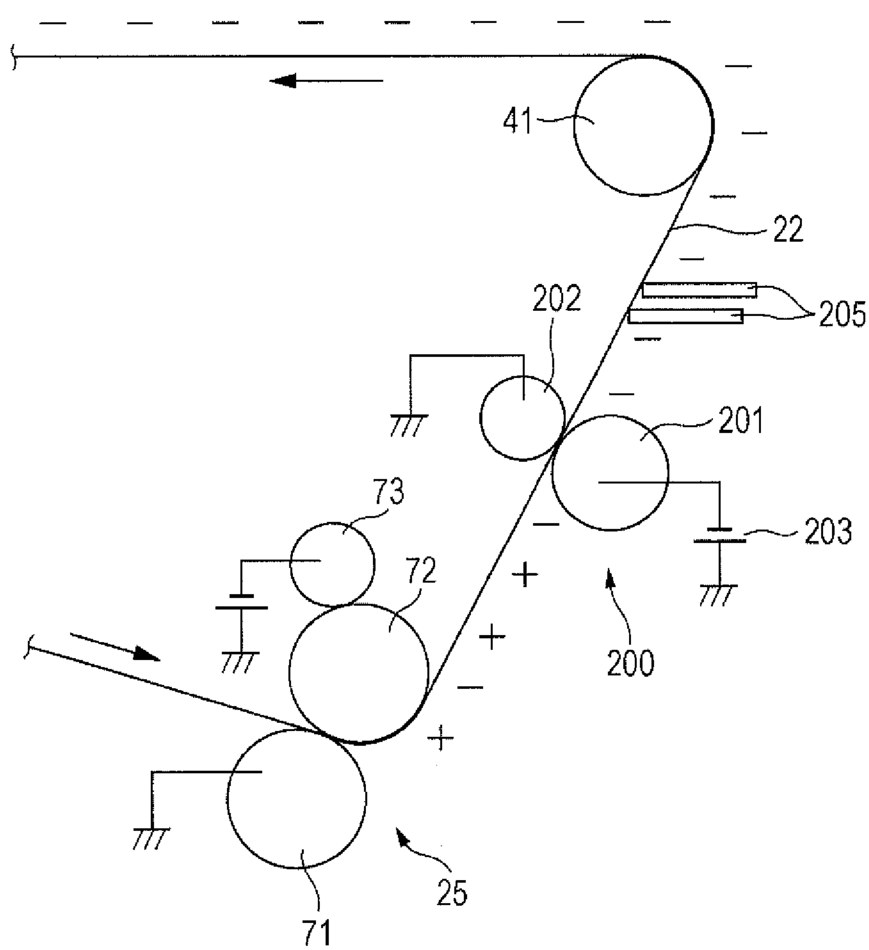
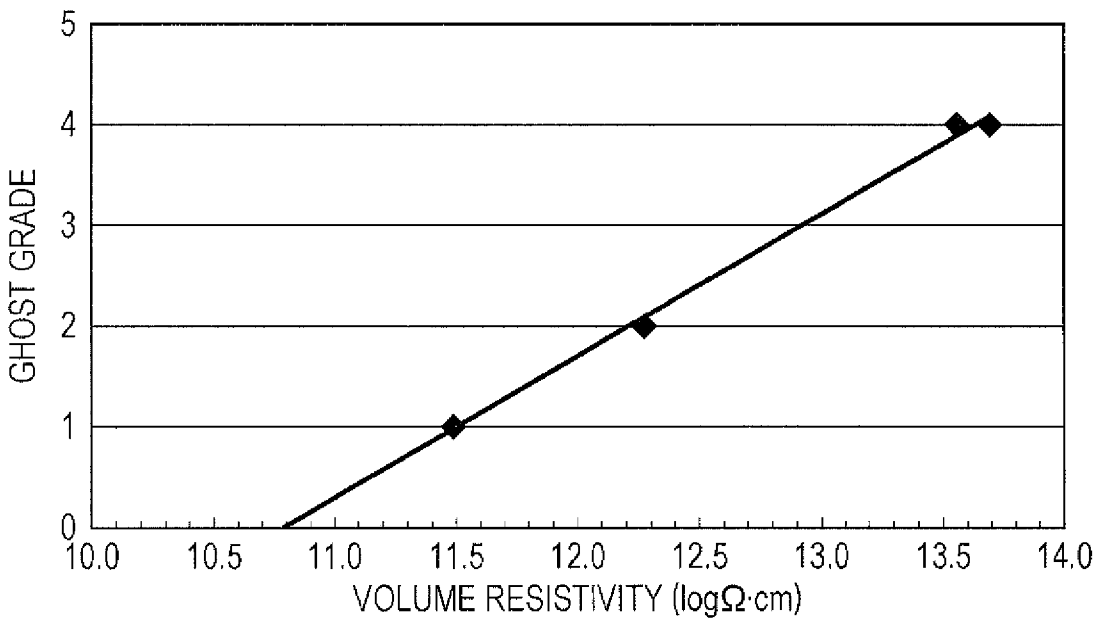


FIG. 16



GHOST GRADE
0
1
2
3
4
5
10.0
10.5
11.0
11.5
12.0
12.5
13.0
13.5
14.0
VOLUME RESISTIVITY (logΩ·cm)

FIG. 17B

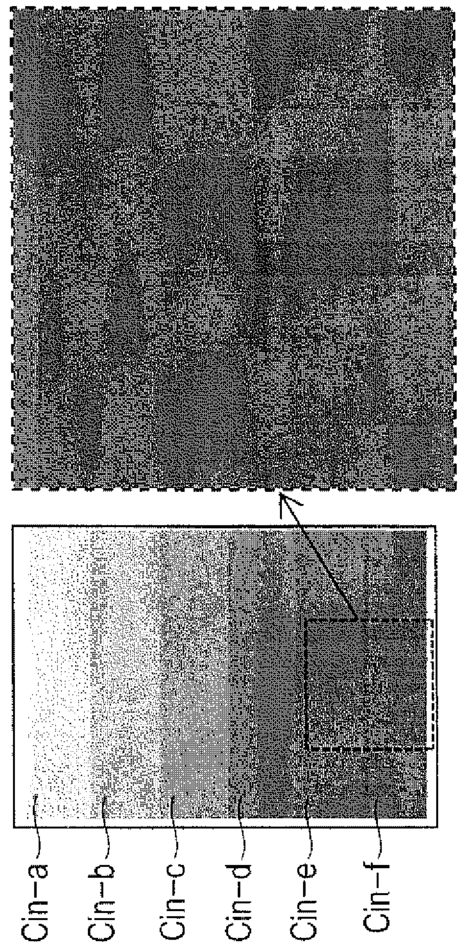


FIG. 17A

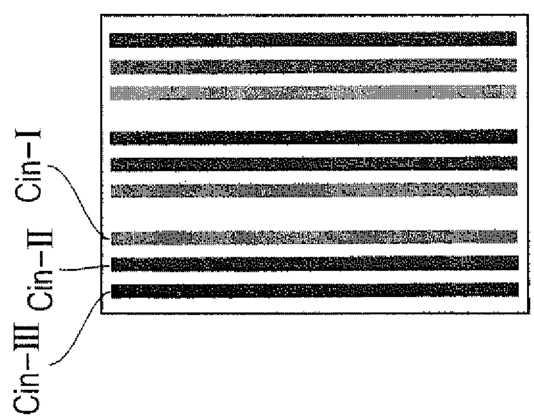


FIG. 18A

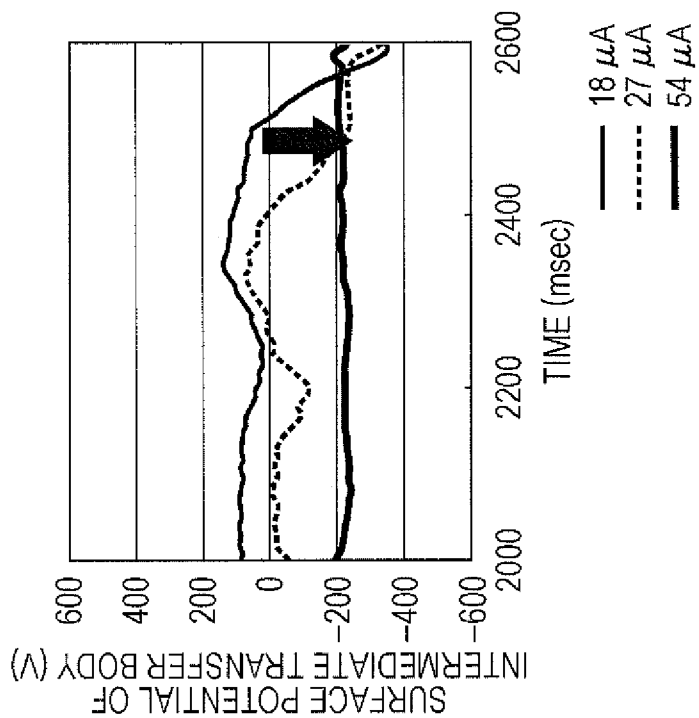


FIG. 18B

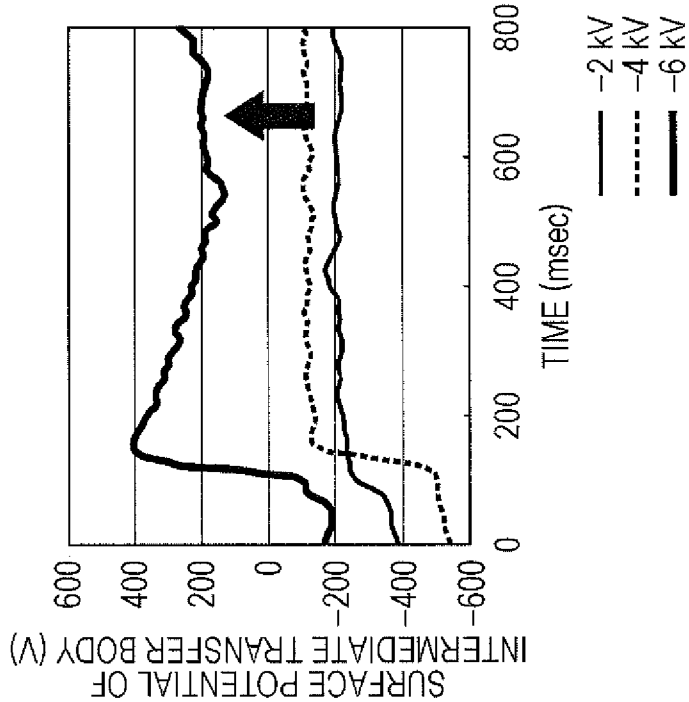


FIG. 19A

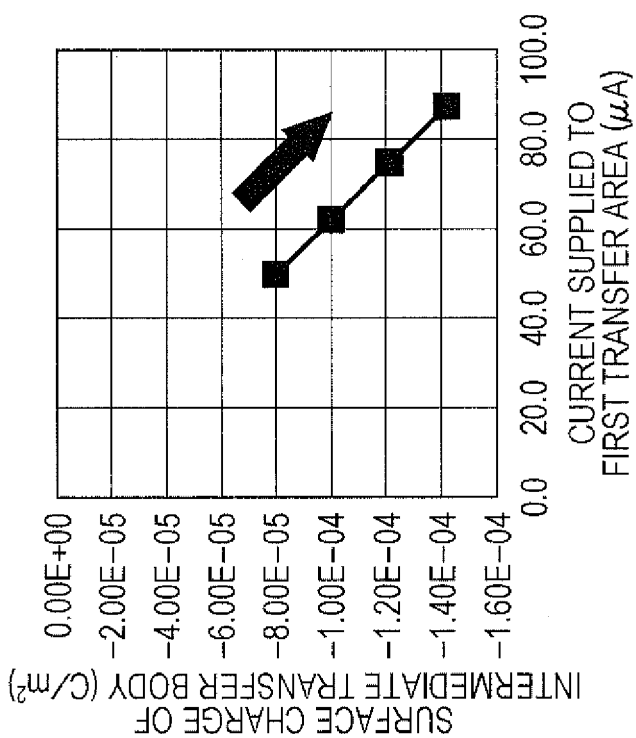


FIG. 19B

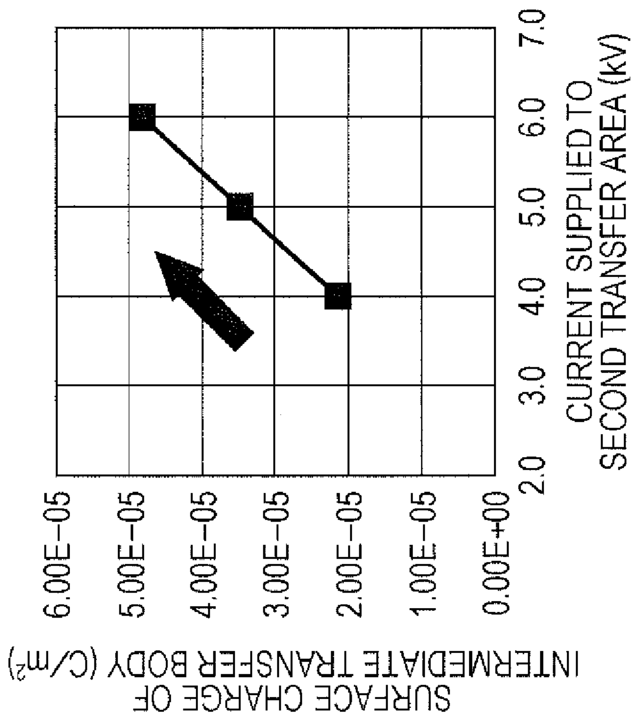


FIG. 20

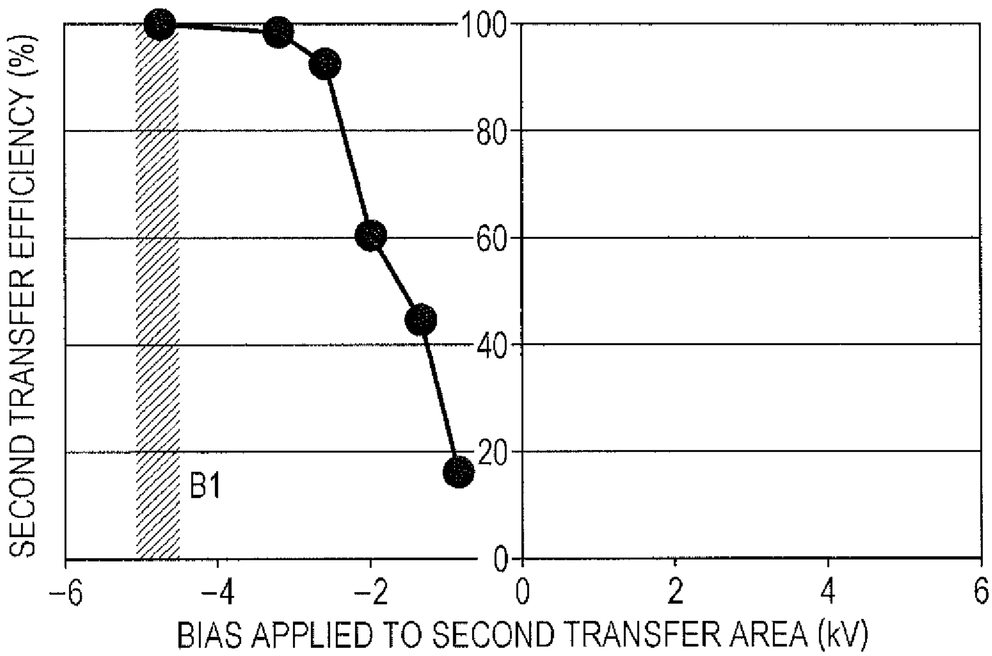
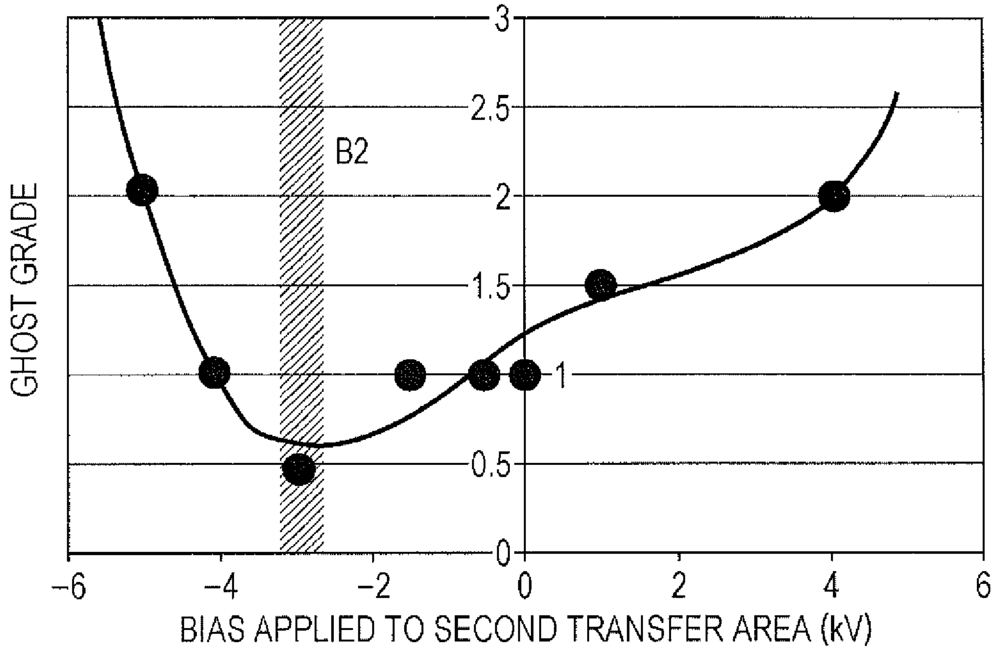

SECOND TRANSFER EFFICIENCY (%)
100
80
60
40
20
0
B1
−6
−4
−2
0
2
4
6
BIAS APPLIED TO SECOND TRANSFER AREA (kV)

FIG. 21



B2
GHOST GRADE
3
2.5
2
1.5
1
0.5
0
−6
−4
−2
0
2
4
6
BIAS APPLIED TO SECOND TRANSFER AREA (kV)

FIG. 22

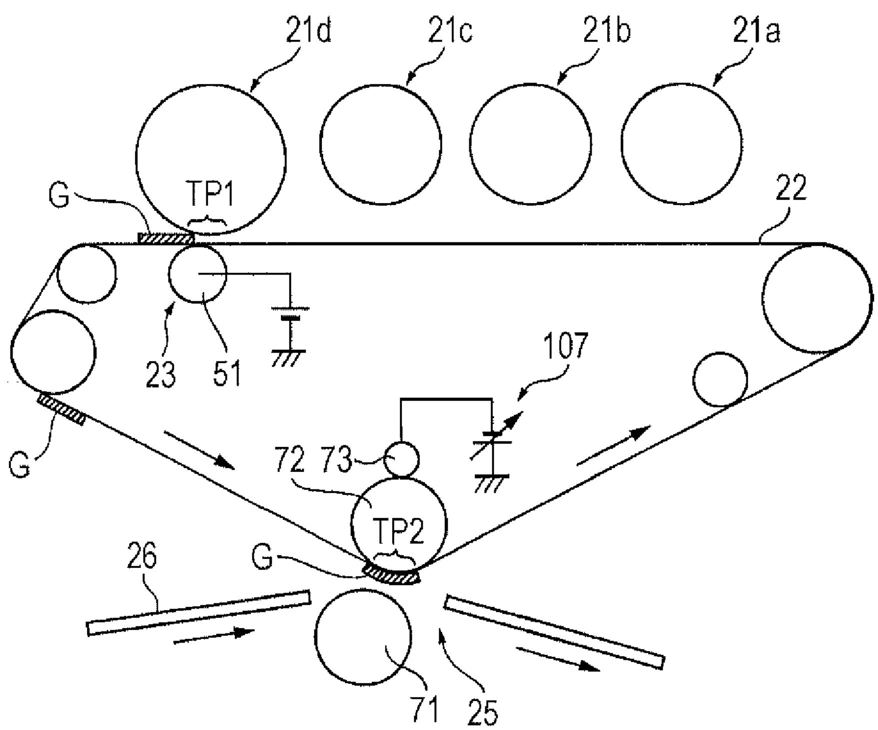


FIG. 23

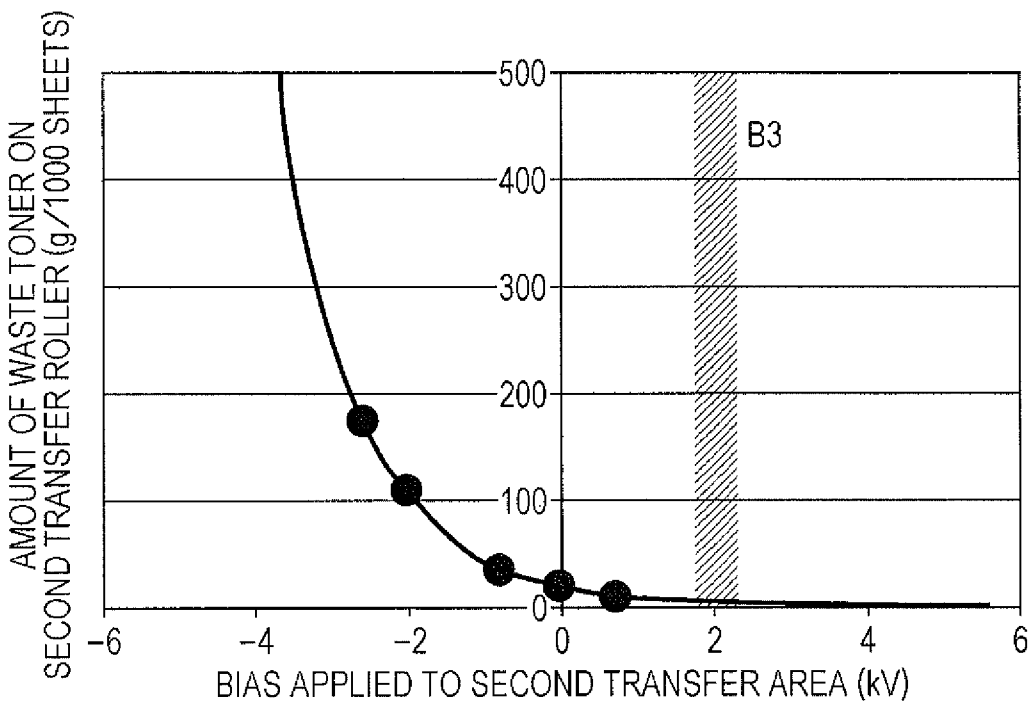

AMOUNT OF WASTE TONER ON SECOND TRANSFER ROLLER (g/1000 SHEETS)
500
400
300
200
100
0
B3
−6
−4
−2
0
2
4
6
BIAS APPLIED TO SECOND TRANSFER AREA (kV)

IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based on and claims priority under 35 USC 119 from Japanese Patent Application No. 2013-129629 filed Jun. 20, 2013.

BACKGROUND

Technical Field

The present invention relates to image forming apparatuses.

SUMMARY

According to an aspect of the invention, there is provided an image forming apparatus including multiple image carriers that carry images formed with color component toners; an intermediate transfer body that is arranged to face the image carriers and is configured to run in a loop, the intermediate transfer body being brought into contact with at least one of the image carriers used for image forming to carry the image formed on the image carrier before transferring the image to a recording material; first transfer devices that include first transfer members arranged to face an inner surface of the intermediate transfer body, at positions corresponding to the image carriers, the first transfer devices forming first-transfer electric fields in first transfer areas between the first transfer members and the image carriers to transfer the images carried on the image carriers to the intermediate transfer body; a second transfer device that includes a second transfer member arranged to face an outer surface of the intermediate transfer body, the second transfer device forms a second-transfer electric field in a second transfer area between the second transfer member and the intermediate transfer body to transfer, to the recording material, the images transferred to the intermediate transfer body by the first transfer devices; and an adjusting device that adjusts an electric field to be formed in the second transfer area to a cleaning electric field, which is of the same polarity as and a lower intensity than the second-transfer electric field, when the image transferred to the intermediate transfer body passes through the second transfer area without a recording material passing therethrough.

According to the above-described aspect, image defects due to charge record remaining in the intermediate transfer body is reduced without complicating the configuration of the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of the present invention will be described in detail based on the following figures, wherein:

FIG. **1** illustrates the outline of exemplary embodiments of an image forming apparatus of the present invention;

FIG. **2** illustrates a technical problem to be handled by the image forming apparatus according to the exemplary embodiments;

FIG. **3** illustrates the overall configuration of an image forming apparatus according to a first exemplary embodiment;

FIG. **4** illustrates a drive and control system of the image forming apparatus according to the first exemplary embodiment;

FIG. **5**A illustrates a retract mechanism of an intermediate transfer body used in the first exemplary embodiment, and FIG. **5**B illustrates the movement of the retract mechanism;

FIGS. **6**A and **6**B illustrate moving states, in an FC mode and in a single K mode, respectively, of the image forming apparatus according to the first exemplary embodiment;

FIG. **7** illustrates an example of a voltage applying device of a second transfer device used in the first exemplary embodiment;

FIG. **8**A illustrates a bias B1 applied to a second transfer area to form a second-transfer electric field E2, FIG. **8**B illustrates a bias B2 applied to the second transfer area to form a cleaning electric field Ec, and FIG. **8***c* illustrates a bias B3 applied to the second transfer area to form a holding electric field Eh;

FIG. **9** is a flowchart of anti-ghost control processing 1 performed in the first exemplary embodiment;

FIG. **10**A illustrates the movement of the second transfer device when a sheet is fed to the second transfer area of the image forming apparatus according to the first exemplary embodiment; FIG. **10**B illustrates the movement of the second transfer device, in the FC mode, when a sheet is not fed to the second transfer area and when a toner patch for process control is made to pass therethrough, and FIG. **10**C illustrates the movement of the second transfer device, in the single K mode, when a sheet is not fed to the second transfer area and when a toner patch for process control is made to pass therethrough;

FIG. **11** is a schematic diagram illustrating changes in the surface potential, in a first transfer area and the second transfer area, of the intermediate transfer body of the image forming apparatus according to the first exemplary embodiment;

FIG. **12** is a flowchart of anti-ghost control processing 2 performed in the first exemplary embodiment;

FIG. **13** is a flowchart of anti-ghost control processing 3 performed in the first exemplary embodiment;

FIG. **14** is a flowchart of anti-ghost control processing 4 performed in the first exemplary embodiment;

FIG. **15** schematically illustrates an example of anti-ghost control processing performed in an image forming apparatus according to a comparative example;

FIG. **16** illustrates the relationship between the volume resistivity of the intermediate transfer body and the ghost grade, in the image forming apparatus according to the first exemplary embodiment;

FIG. **17**A illustrates a ghost chart used to evaluate the ghost grade in the image forming apparatus according to the first exemplary embodiment, and FIG. **17**B is a resulting ghost evaluation chart;

FIG. **18**A illustrates the relationship between a current supplied to a first transfer area and the surface potential of an intermediate transfer body of an image forming apparatus according to a second exemplary embodiment, and FIG. **18**B illustrates the relationship between a bias applied to a second transfer area and the surface potential of the intermediate transfer body of the image forming apparatus according to the second exemplary embodiment;

FIG. **19**A illustrates a change in surface charge of the intermediate transfer body of the image forming apparatus according to the second exemplary embodiment occurring when a current supplied to the first transfer area is increased, and FIG. **19**B illustrates a change in the surface charge of the intermediate transfer body of the image forming apparatus according to the second exemplary embodiment occurring when a bias applied to the second transfer area is increased;

FIG. **20** is a graph showing how to determine the bias B1 applied to form the second-transfer electric field, on the basis of the relationship between the bias applied to the second transfer area and the second transfer efficiency, in an image forming apparatus according to a third exemplary embodiment;

FIG. **21** is a graph showing how to determine the bias B2 applied to form a cleaning electric field, on the basis of the relationship between the bias applied to the second transfer area and the ghost grade, in the image forming apparatus according to the third exemplary embodiment;

FIG. **22** illustrates the conditions for evaluating the ghost grade shown in FIG. **21**;

FIG. **23** is a graph showing how to determine the bias B3 applied to form a holding electric field, on the basis of the relationship between the bias applied to the second transfer area and the amount of waste toner on the second transfer roller, in the image forming apparatus according to the third exemplary embodiment.

DETAILED DESCRIPTION

Outline of Exemplary Embodiment

FIG. **1** illustrates the outline of exemplary embodiments of an image forming apparatus of the present invention.

In FIG. **1**, the image forming apparatus includes multiple image carriers **1** (in this example, **1***a* to **1***d*) that form and carry images G composed of color component toners; an intermediate transfer body **2** that is arranged to face the image carriers **1** and is configured to run in a loop, the intermediate transfer body **2** being brought into contact with at least one of the image carriers **1** (for example, **1***d*) used for image forming to temporarily carry the image G formed on this image carrier **1** before transferring the image G to a recording material **15**; first transfer devices **3** that include first transfer members **3***a* arranged to face an inner surface of the intermediate transfer body **2**, at positions corresponding to the image carriers **1**, the first transfer devices **3** forming first-transfer electric fields E1 in first transfer areas TP1 between the first transfer members **3***a* and the image carriers **1** to transfer the images G carried on the image carriers **1** to the intermediate transfer body **2**; a second transfer device **5** that includes a second transfer member **5***a* arranged to face an outer surface of the intermediate transfer body **2**, the second transfer device **5** transferring the images G transferred to the intermediate transfer body **2** by the first transfer devices **3** to the recording material **15** by forming a second-transfer electric field E2 in a second transfer area TP2 between the second transfer member **5***a* and the intermediate transfer body **2**; and an adjusting device **10** that adjusts an electric field to be formed in the second transfer area TP2 to a cleaning electric field Ec, which is of the same polarity as and a lower intensity than the second-transfer electric field E2, when the images G transferred to the intermediate transfer body **2** pass through the second transfer area TP2 without the recording material **15** passing therethrough.

In this technical solution, this exemplary embodiment deals with a tandem image forming apparatus of an intermediate transfer type, in which multiple image carriers **1** (for example, **1***a* to **1***d*) are arranged along the intermediate transfer body **2**.

This exemplary embodiment not only includes a configuration in which only the image carrier **1** used for the image-forming operation (for example, **1***d*) is brought into contact with the intermediate transfer body **2** by a contacting/retracting mechanism **6**, but also a configuration in which the multiple image carriers **1** and the intermediate transfer body **2** are constantly in contact with each other.

The first transfer members **3***a* of the first transfer devices **3** may be either transfer rollers that are in contact with the intermediate transfer body **2** or corotrons disposed in a non-contact manner.

The second transfer member **5***a* of the second transfer device **5** may also be either a transfer roller or a transfer belt that transports the recording material **15** nipped with respect to the intermediate transfer body **2**, or a corotron disposed in a non-contact manner. When the second transfer member **5***a* disposed in a non-contact manner is employed, a functional member that guides the recording material **15** may be separately provided.

The adjusting device **10** adjusts an electric field acting on the second transfer area TP2 when the image G passes through the second transfer area TP2 without the recording material **15** passing therethrough.

In this exemplary embodiment, the cleaning electric field Ec is of the same polarity as and a lower intensity than the second-transfer electric field E2. If an electric field of opposite polarity is formed, even though the absolute value thereof is smaller than that of the second-transfer electric field E2, it is not enough to eliminate a charge record difference left in the intermediate transfer body **2**. Furthermore, if the cleaning electric field Ec is of the same polarity as and has higher intensity than the second-transfer electric field, the charge record difference left in the intermediate transfer body **2** becomes more evident, and the amount of waste toner moved to the second transfer member increases.

The image forming apparatus according to this exemplary embodiment effectively suppresses a so-called ghost phenomenon due to an image record shown in FIG. **2**.

As shown in FIG. **1**, in a tandem image forming apparatus of an intermediate transfer type, the intermediate transfer body **2** is subjected to the first-transfer electric fields E1 in the first transfer areas TP1 and is subjected to the second-transfer electric field E2 in the second transfer area TP2. Thus, when a continuous image forming operation is finished and a subsequent image forming operation is started, a charge record (the difference in amount of charge between an image portion and a non-image portion) W resulting from the first and second transfers may remain in the intermediate transfer body **2**, as indicated by a reference numeral "I" in FIG. **2**.

If this charge record W is large, when, for example, the image carriers **1** form a halftone image G in the subsequent image forming operation, after a portion of the intermediate transfer body **2** having a large charge record W passes through the first transfer areas TP1 of the image carriers **1**, toner used to form an image scatters due to the charge record W, as indicated by a reference numeral "II" in FIG. **2**, causing unevenness of an image and making image quality defects (i.e., ghost) due to charge record W more evident.

To suppress the ghost phenomenon, this exemplary embodiment is configured to apply a predetermined cleaning electric field Ec to the second transfer area TP2 to reduce the charge record W causing the ghost phenomenon.

The ghost phenomenon is more evident in the intermediate transfer bodies **2** having higher resistances, because such intermediate transfer bodies **2** retain a greater amount of charge.

Next, exemplary or suitable configurations of the image forming apparatus according to this exemplary embodiment will be described.

First, the adjusting device **10** selects such a cleaning electric field Ec that the residual charge difference between the image portion and the non-image portion formed on the intermediate transfer body **2** having passed through the second transfer area TP2 is less than or equal to a predetermined threshold.

The cleaning electric field Ec may be any electric field as long as it is of the same polarity as and a lower intensity than the second-transfer electric field E2, but, ideally, the cleaning electric field Ec may be selected such that the residual charge difference between the image portion and the non-image portion of the intermediate transfer body **2** having passed through the second transfer area TP2 is within a predetermined threshold. Because the level of the image defect (ghost grade) due to an image record (residual charge difference) gradually decreases in accordance with the voltage for forming the cleaning electric field Ec and becomes minimum at a certain voltage, the cleaning electric field Ec may be selected such that the ghost grade is minimized.

Furthermore, the image forming apparatus includes the contacting/retracting mechanism **6** that relatively brings the intermediate transfer body **2** into contact with or retracted from the image carriers **1** such that the image carrier **1** used for the image-forming operation (for example, **1***d*) comes into contact with the intermediate transfer body **2** and such that the image carriers **1** not used for the image-forming operation (for example, **1***a* to **1***c*) are not in contact with the intermediate transfer body **2**; and a contact-state selecting device **9** that selects, using the contacting/retracting mechanism **6**, a full contact mode, in which the intermediate transfer body **2** is in contact with all the image carriers **1**, or a partial contact mode, in which the intermediate transfer body **2** is in contact with at least one, but not all, of the image carriers **1** (for example, **1***d*). When the contact-state selecting device **9** selects the partial contact mode, the adjusting device **10** adjusts the electric field to be formed in the second transfer area TP2 to the cleaning electric field Ec, and when the contact-state selecting device **9** selects the full contact mode, the adjusting device **10** adjusts the electric field to be formed in the second transfer area TP2 to a holding electric field Eh, which serves to hold an image, which is of opposite polarity to the second-transfer electric field E2.

The contacting/retracting mechanism **6** brings the image carrier **1** used for the image-forming operation into contact with the intermediate transfer body **2** and brings the other image carriers **1** away from the intermediate transfer body **2**. Although various configurations, such as a configuration in which the intermediate transfer body **2** is moved relative to the fixed image carriers **1**, a configuration in which the image carriers **1** are moved relative to the fixed intermediate transfer body **2**, and a configuration in which both the image carriers **1** and the intermediate transfer body **2** are moved, are possible, a configuration in which the image carriers **1** are fixed is suitable to precisely form images on the image carriers **1**.

Because image quality defects due to charge record remaining in the intermediate transfer body **2** tend to occur in the partial contact mode (for example, when an image carrier for forming a single black toner image is used), the cleaning electric field Ec is formed in the second transfer area TP2 only when the partial contact mode is selected. In the full contact mode, such a charge record remaining in the intermediate transfer body **2**, if any, is gradually evened out as the intermediate transfer body **2** passes through the first transfer areas TP1 of the image carriers **1** (**1***a* to **1***d*), so, image quality defects due to charge record are less likely to occur. Thus, instead of the cleaning electric field Ec, the holding electric field Eh is formed in the second transfer area TP2 to reduce the amount of waste toner.

Furthermore, in the image forming apparatus including the contacting/retracting mechanism **6**, the image carrier **1** (in this exemplary embodiment, **1***a*) located on the most upstream side, in the moving direction of the intermediate transfer body **2**, among the multiple image carriers **1** forms an image with a less visible color component toner (such as yellow toner or clear toner) than the other color component toners.

When the full contact mode is selected, if the image carrier **1** located on the most upstream side, in the moving direction of the intermediate transfer body **2**, forms an image with a less visible color component toner, even if the intermediate transfer body **2** having a residual charge difference passes through the first transfer area TP1 of the image carrier **1** located on the most upstream side (for example, **1***a*), causing unevenness of an image due to the residual charge difference, the unevenness of the image is less noticeable than that in a case where a highly visible toner is used. Very little unevenness of an image due to a residual charge difference is observed in the image carriers located on the downstream side because the residual potential difference is gradually evened out as the intermediate transfer body **2** passes through the first transfer areas TP1.

Furthermore, in the image forming apparatus including the contacting/retracting mechanism **6**, the image carrier **1** for forming a black toner image is located on the most downstream side, in the moving direction of the intermediate transfer body **2**, and is in contact with the intermediate transfer body **2** to be used to form an image, in either image forming state in which one image carrier **1** is used or multiple image carriers **1** are used.

The image carrier **1** (in this exemplary embodiment, **1***d*) located on the most downstream side, in the moving direction of the intermediate transfer body **2**, forms a black toner image.

In any image formation mode, i.e., a full-color mode, a single black mode, or a two-color mode including black, the image carrier **1** for forming black toner images (in this exemplary embodiment, **1***d*) is always used for the image-forming operation and is in contact with the intermediate transfer body **2**.

For example, when the partial contact mode is selected, the charge record remaining in the intermediate transfer body **2** is reduced by the cleaning electric field Ec formed in the second transfer area TP2, before the intermediate transfer body **2** passes through the first transfer area TP1 of the image carrier **1***d* for forming black toner images. Thus, image quality defects due to charge record of the intermediate transfer body **2** do not occur. Furthermore, for example, when the single black mode is selected, the distance between the image carrier **1***d* located on the most downstream side and the second transfer area TP2 in the second transfer device **5** is smaller than that in other configurations. Thus, the time taken to form a black image is reduced.

Furthermore, the image forming apparatus includes an image-quality selecting device **11** that selects image-quality priority processing in which the priority is given to the quality of a transferred image. When the image-quality selecting device **11** selects the image-quality priority processing, the adjusting device **10** adjusts the electric field to be formed in the second transfer area TP2 to the cleaning electric field Ec, and when the image-quality selecting device **11** does not select the image-quality priority processing, the adjusting device **10** adjusts the electric field to be formed in the second transfer area TP2 to the holding electric field Eh, which is of opposite polarity to the second-transfer electric field E1.

The electric field adjusted by the adjusting device **10** is switched, between the image-quality priority mode, in which the image-quality priority processing is performed, and the mode in which the image-quality priority processing is not performed.

In this exemplary embodiment, when the image-quality priority mode is selected, a predetermined cleaning electric field Ec is selected to suppress image quality defects due to charge record remaining in the intermediate transfer body **2**, and, when there is no need for that, the holding electric field Eh is selected instead of the cleaning electric field Ec to reduce the amount of waste toner transferred to the second transfer member **5***a*.

Furthermore, the image forming apparatus includes a speed selecting device **12** that selects, according to the type of the image to be formed, the speed of the image-forming processing performed on the image carriers **1** and the intermediate transfer body **2** during the image forming operation. When the speed selecting device **12** selects speed priority processing, in which an image-forming operation is performed at a speed higher than a predetermined speed, the adjusting device **10** adjusts the electric field to be formed in the second transfer area TP2 to the cleaning electric field Ec, and when the speed selecting device **12** does not select the speed priority processing, the adjusting device **10** adjusts the electric field to be formed in the second transfer area TP2 to the holding electric field Eh, which is of opposite polarity to the second-transfer electric field E2.

The electric field adjusted by the adjusting device **10** is switched, between the speed priority mode, in which the speed priority processing is performed, and the mode in which the speed priority processing is not performed.

In this exemplary embodiment, when the speed priority mode is selected, a predetermined cleaning electric field Ec is selected to suppress image quality defects due to charge record remaining in the intermediate transfer body **2**, and, when there is no need for that, the holding electric field Eh is selected instead of the cleaning electric field Ec to reduce the amount of waste toner transferred to the second transfer member **5***a*.

In the image forming apparatus including the speed selecting device **12**, the image forming apparatus includes a driving control device **13**. When the speed selecting device **12** does not select the speed priority processing, and after the holding electric field Eh is applied to the second transfer area TP2 by the adjusting device **10**, the driving control device **13** causes the intermediate transfer body **2** to make one free revolution, while applying a predetermined electric field to either the first transfer areas TP1 or the second transfer area TP2.

When the speed priority processing is not performed, the driving control device **13** causes the intermediate transfer body **2** to make one free revolution, while applying a predetermined electric field to either the first transfer areas TP1 or the second transfer area TP2. As a result, the charge record remaining in the intermediate transfer body **2** is gradually evened out while the intermediate transfer body **2** makes one free revolution.

Furthermore, the image forming apparatus includes a frequency prediction device **14** that predicts the frequency at which the image G transferred to the intermediate transfer body **2** passes through the second transfer area TP2 without the recording material **15** passing therethrough. When the frequency predicted by the frequency prediction device **14** is greater than or equal to a predetermined frequency, the adjusting device **10** adjusts the electric field to be formed in the second transfer area TP2 to the cleaning electric field Ec, and when the frequency predicted by the frequency prediction device **14** is less than the predetermined frequency, the adjusting device **10** adjusts the electric field to be formed in the second transfer area TP2 to the holding electric field Eh, which is of opposite polarity to the second-transfer electric field E2.

The frequency at which the image G on the intermediate transfer body **2** passes through the second transfer area TP2 without the recording material **15** passing therethrough, is predicted, and the electric field to be adjusted by the adjusting device **10** is switched according to the frequency.

In this exemplary embodiment, if the frequency is high, the charge record tends to remain in the intermediate transfer body **2**, so, a predetermined cleaning electric field Ec is selected to suppress image quality defects due to charge record, and if the frequency is low, the charge record is less likely to remain in the intermediate transfer body **2**, so, the holding electric field Eh is selected instead of the cleaning electric field Ec to reduce the amount of waste toner transferred to the second transfer member **5***a*.

Furthermore, when the intermediate transfer body **2** carrying no image G passes through the second transfer area TP2 without the recording material **15** passing therethrough, the adjusting device **10** adjusts the electric field to be formed in the second transfer area TP2 to the cleaning electric field Ec.

In general, when an area of the intermediate transfer body **2** carrying no image G passes through the second transfer area TP2 without the recording material **15** passing therethrough, the area receives the influence of the electric field. However, in this exemplary embodiment, because the area of the intermediate transfer body **2** carrying no image G receives the influence of the cleaning electric field Ec when passing through the second transfer area TP2, the charge record in this area is reduced.

Furthermore, the relationship $|B1-B3|>|B1-B2|$ is satisfied, where B1, B2, and B3 are voltages applied by the adjusting device **10** to form the second-transfer electric field E2, the cleaning electric field Ec, and the holding electric field Eh, respectively, in the second transfer area TP2.

When the toner used for the image-forming operation is negatively charged, the electric fields E2 and Ec are negative, and the electric field Eh is positive. Thus, the voltages B1 to B3 are values in the polarity of the corresponding electric fields. On the other hand, when the toner used for the image-forming operation is positively charged, the electric fields E2 and Ec are positive and the electric field Eh is negative. Thus, the voltages B1 to B3 are values in the polarity of the corresponding electric fields.

Furthermore, the intermediate transfer body **2** has a base member and a surface layer. The surface layer has higher surface resistivity than the base member. The surface layer having high surface resistivity provides improved capability of carrying images (toner) on the intermediate transfer body **2**, and the base member having low surface resistivity suppresses discharge to the first transfer members **3***a*. Thus, the image quality is further improved.

Furthermore, in the adjusting device **10**, the second transfer device **5** includes an electric-field forming device that forms the second-transfer electric field E2 in the second transfer area TP2, and the adjusting device **10** serves a dual function as the electric-field forming device. The adjusting device **10** serves a dual function as the electric-field forming device of the second transfer device **5**, contributing to a reduction in the number of components, compared with a case where such a device is separately provided.

Next, the present invention will be described in more detail according to various exemplary embodiments shown in the attached drawings.

First Exemplary Embodiment

Overall Configuration of Image Forming Apparatus

FIG. **3** illustrates the overall configuration of an image forming apparatus according to the first exemplary embodiment.

In FIG. **3**, an image forming apparatus **20** is a tandem image forming apparatus of an intermediate transfer type and includes multiple color-component image forming units **21***a* to **21***d* (collectively, **21**, and corresponding to yellow (Y), magenta (M), cyan (C), and black (K), in this exemplary embodiment) that are arranged in a substantially horizontal transverse direction. A belt-shaped intermediate transfer body **22**, which is configured to revolve, is provided so as to face the image forming units **21**. First transfer devices **23***a* to **23***d* (collectively, **23**) are provided adjacent to the inner surface of the intermediate transfer body **22**, at positions corresponding to the image forming units **21**. The first transfer devices **23** transfer images formed with the color component toners (hereinbelow, color component toner images) in the image forming units **21** to the intermediate transfer body **22** (hereinbelow, first transfer). A second transfer device **25** that transfers the color component images, transferred to the intermediate transfer body **22**, to a sheet **26**, serving as a recording material, (hereinbelow, second transfer or simultaneous transfer) is provided at a portion of the intermediate transfer body **22** located on the downstream side of the image forming unit **21** on the most downstream side, in the moving direction of the intermediate transfer body **22** (in this exemplary embodiment, **21***d*).

The image forming apparatus **20** according to this exemplary embodiment further includes a fixing device **27** that fixes the image simultaneously transferred onto the sheet **26** at the second transfer device **25** to the sheet **26**, and a sheet transport system **28** that transports the sheet **26** to a position where the second transfer device **25** performs the second transfer or to a position where the fixing device **27** performs fixing.

In this exemplary embodiment, each of the image forming units **21***a* to **21***d* includes a drum-shaped photosensitive member **31**; a charger **32**, such as a corotron, that charges the photosensitive member **31**; an exposure device **33**, such as a laser scanning device, that forms an electrostatic latent image on the charged photosensitive member **31**; a developing device **34** that develops the electrostatic latent image formed on the photosensitive member **31** with color component toner; and a cleaning device **35** that removes the residual toner on the photosensitive member **31**. The charger **32**, the exposure device **33**, the developing device, and the cleaning device **35** are arranged so as to surround the photosensitive member **31**.

The intermediate transfer body **22** is stretched over multiple (in this exemplary embodiment, five) stretching rollers **41** to **45**. The stretching roller **41** is used as a driving roller driven by a driving motor (not shown), and the stretching rollers **42** to **45** are used as driven rollers. The stretching roller **43** is used as a correcting roller that prevents the intermediate transfer body **22** from moving in a width direction, which substantially crosses the moving direction of the intermediate transfer body **22**, and the stretching roller **44** is used as an opposing roller disposed opposite the second transfer device **25**. Furthermore, a cleaning device **47** that removes residual toner on the intermediate transfer body **22** after the second transfer is provided adjacent to the outer surface of the intermediate transfer body **22**, at a position facing the stretching roller **41**.

In this exemplary embodiment, the intermediate transfer body **22** has a base member and a surface layer, and the surface layer has higher volume resistivity than the base member. The volume resistivity of the surface layer is 11 (log Ω·cm) or more, and the volume resistivity of the base member is 10 (log Ω·cm) or less.

The intermediate transfer body **22** having such a volume resistivity is suitable because, due to its high surface resistivity, it has good capability of carrying toner images and, thus, forms high-quality images. However, because the volume resistivity of the entire intermediate transfer body **22** is also high, the charge record remaining in the intermediate transfer body **22** is less likely to disappear, resulting in image quality defects due to charge record.

Furthermore, in this exemplary embodiment, the first transfer devices **23** include first transfer rollers **51** that are in contact with the inner surface of the intermediate transfer body **22**, at positions corresponding to the photosensitive members **31**. By urging the first transfer rollers **51** against the photosensitive members **31** with a predetermined load, contact areas (nip areas), serving as the first transfer areas TP1, are formed between the photosensitive members **31** and the intermediate transfer body **22**. Furthermore, by supplying a predetermined first transfer current to the first transfer rollers **51**, the first-transfer electric fields E1 are formed in the first transfer areas TP1, by which the color component toner images on the photosensitive members **31** are transferred to the intermediate transfer body **22**. In this exemplary embodiment, because the base member of the intermediate transfer body **22** has a low volume resistivity, the intermediate transfer body **22** does not unnecessarily discharge, even if it is in contact with the first transfer rollers **51**.

Furthermore, as shown in FIGS. **3**, **4**, and **7**, the second transfer device **25** includes a second transfer roller **71** that is in contact with the outer surface of the intermediate transfer body **22**, at a position corresponding to the stretching roller **44**, thereby forming a contact area (nip area), serving as the second transfer area TP2, between the second transfer roller **71** and the intermediate transfer body **22**. A power-supply roller **73** is in contact with the surface of the stretching roller **44**, which serves as the opposing roller **72** facing the second transfer roller **71**. By applying a predetermined second transfer voltage to the power-supply roller **73**, and by grounding the second transfer roller **71**, the second-transfer electric field E2 is formed in the second transfer area TP2, thereby transferring the color component toner images on the intermediate transfer body **22** to the sheet **26**.

The fixing device **27** includes a heat-fixing roller **81** that has, for example, an internal heat source, and a press-fixing roller **82** that is pressed against the heat-fixing roller **81** and is rotated by the rotation of the heat-fixing roller **81**. The unfixed image on the sheet **26** is heated and pressed between the fixing rollers **81** and **82**, and thus, fixed.

The sheet transport system **28** feeds the sheet **26** stored in a sheet container **91** to a sheet transport path by a feed roller **92**. An appropriate number of transport rollers **93** are provided in the sheet transport path. Positioning rollers **94**, which supply the sheet **26** to the second transfer area TP2 at a predetermined time after positioning the sheet **26**, are provided in the sheet transport path immediately before the second transfer area TP2. Furthermore, transport belts **95** that transport the sheet **26** to the fixing device **27** are provided downstream of the second transfer area TP2 in the sheet transport path.

The sheet **26** having passed through the fixing device **27** is output onto, for example, a sheet output container (not shown) via an output roller (not shown).

Drive and Control System of the Image Forming Apparatus

FIG. **4** illustrates a drive and control system for the image forming apparatus according to the first exemplary embodiment.

In FIG. **4**, a control device **100** controls image forming operation performed by the image forming apparatus. The control device **100** is formed of a microcomputer including a central processing unit (CPU), a read-only memory (ROM), a random-access memory (RAM), and input/output interfaces. The control device **100** obtains, through the input/output interfaces, input signals from a start switch (not shown), an image formation mode switch **131** for selecting an image formation mode, an image-quality-priority mode switch **132** for selecting an image-quality priority mode in which priority is given to the image quality, and a speed-priority mode switch **133** for selecting a speed priority mode in which priority is given to the image-forming processing speed. The control device **100** executes, by the CPU, an anti-ghost control processing program (see FIGS. **9** and **12** to **14**) stored in the ROM, generates control signals for the drive control targets, and transmits the control signals for the drive control targets.

In FIG. **4**, the drive control targets include a photosensitive-member driving system **102** that drives the photosensitive members **31** of the image forming units **21***a* to **21***d*; an intermediate-transfer-body driving system **103** that causes the intermediate transfer body **22** to revolve by rotating, for example, the stretching roller **41** serving as the driving roller; a retract mechanism **104** that brings the intermediate transfer body **22** toward or away from the photosensitive members **31** of the image forming units **21***a* to **21***d*; a current supply device **106** that supplies a first transfer current to the first transfer rollers **51** of the first transfer devices **23** in the image forming units **21**; and a voltage applying device **107** that applies various voltages, including the second transfer voltage, to the power-supply roller **73** in the second transfer device **25**.

Retract Mechanism

FIGS. **5**A and **5**B illustrates the details of the retract mechanism **104** used in this exemplary embodiment.

In FIGS. **5**A and B, the retract mechanism **104** brings the intermediate transfer body **22** toward or away from the photosensitive members **31** of the image forming units **21***a* to **21***c* other than the image forming unit **21***d* located on the most downstream side, in the moving direction of the intermediate transfer body **22**. In this exemplary embodiment, when the intermediate transfer body **22** is retracted from the photosensitive members **31** of the image forming units **21***a* to **21***c*, the first transfer rollers **51** of the first transfer devices **23** corresponding to the image forming units **21***a* to **21***c* are retracted to positions where they are not in contact with the intermediate transfer body **22**.

The retract mechanism **104** includes an intermediate-transfer-body contacting/retracting mechanism **110** that brings the intermediate transfer body **22** toward or away from the photosensitive members **31** of the image forming units **21** (in this exemplary embodiment, the image forming units **21***a* to **21***c*), and a cooperative mechanism **120** that moves in cooperation with the intermediate-transfer-body contacting/retracting mechanism **110** to bring the first transfer devices **23** (in this exemplary embodiment, the first transfer devices **23***a* to **23***c*) corresponding to the image forming units **21** (**21***a* to **21***c*) toward or away from the intermediate transfer body **22**.

The intermediate-transfer-body contacting/retracting mechanism **110** includes a fixed positioning roller **111** and a movable positioning roller **112**, which serve to restrict the position of the intermediate transfer body **22**. The fixed positioning roller **111** is located at a position between the image forming units **21***c* and **21***d* and adjacent to the inner surface of the intermediate transfer body **22**. The movable positioning roller **112** is located at a position upstream of the image forming unit **21***a*, which is located on the most upstream side, in the moving direction of the intermediate transfer body **22**, and adjacent to the inner surface of the intermediate transfer body **22**. This movable positioning roller **112** is supported by a pivot stage **113** that pivots about a pivot fulcrum **114**.

As shown in FIG. **5**B, a driving system for the intermediate-transfer-body contacting/retracting mechanism **110** includes a driving motor **115** that starts to rotate based on a control signal from the control device **100**. The driving force of the driving motor **115** is transmitted to the pivot fulcrum **114** of the pivot stage **113** through a driving-force transmitting mechanism **116**, such as gears and a belt.

The cooperative mechanism **120** includes a pivot plate **121** that pivots about a pivot fulcrum **122** inside the intermediate transfer body **22**. The pivot fulcrum **122** is located at an intermediate position between the image forming units **21***c* and **21***d*. The first transfer devices **23***a* to **23***c* are provided in a fixed manner on the pivot plate **121**. The pivot plate **121** is urged toward the intermediate transfer body **22** by an urging coil **123**. Furthermore, a rotation member **124** that rotates in association with the pivot of the pivot stage **113** is provided at the pivot fulcrum **114** of the pivot stage **113** of the intermediate-transfer-body contacting/retracting mechanism **110**, and an engaging piece **125** is provided away from the pivot fulcrum **114** of the rotation member **124**. The engaging piece **125** is engaged with a free end of the pivot plate **121**.

In this retract mechanism **104**, for example, in the full contact mode, in which the intermediate transfer body **22** is in contact with the photosensitive members **31** of all the image forming units **21***a* to **21***d*, as shown in FIG. **5**B, the movable positioning roller **112** of the intermediate-transfer-body contacting/retracting mechanism **110** is advanced to an advanced position indicated by a solid line.

At this time, a portion of the intermediate transfer body **22** corresponding to the image forming units **21***a* to **21***c* is positioned by the fixed positioning roller **111** and the movable positioning roller **112**, as shown in FIG. **6**A, such that the photosensitive members **31** of the image forming units **21** (**21***a* to **21***c*), as well as the first transfer rollers **51** of the first transfer devices **23** (**23***a* to **23***c*) corresponding to the image forming units **21** (**21***a* to **21***c*), are in contact with the intermediate transfer body **22**.

On the other hand, in the partial contact mode in which the intermediate transfer body **22** is not in contact with the photosensitive members **31** of the image forming units **21** (**21***a* to **21***c*) except for the image forming unit **21***d* located on the most downstream side, as shown in FIG. **5**B, the movable positioning roller **112** of the intermediate-transfer-body contacting/retracting mechanism **110** is retracted to a retract position indicated by a two-dot chain line.

At this time, as shown in FIG. **6**B, the portion of the intermediate transfer body **22** corresponding to the image forming units **21** (**21***a* to **21***c*) is positioned by the fixed positioning roller **111** and the stretching roller **41**, and the photosensitive members **31** of the image forming units **21** (**21***a* to **21***c*) are not in contact with the intermediate transfer body **22**, and the intermediate transfer body **22** is not in contact with the movable positioning roller **112** retracted to the retract position. Furthermore, as shown in FIG. **5**B, as a result of the movable positioning roller **112** being retracted to the retract position, the rotation member **124** of the cooperative mechanism **120** moves to the position shown by the two-dot chain line, causing the pivot plate **121** to pivot downward about the pivot fulcrum **122** via the engaging piece **125**.

Thus, the first transfer devices **23** (in this exemplary embodiment, the first transfer devices **23***a* to **23***c*) provided on the pivot plate **121** are not in contact with the intermediate transfer body **22**.

Voltage Applying Device

FIG. **7** illustrates the voltage applying device **107** used in this exemplary embodiment.

In FIG. **7**, the voltage applying device **107** includes a first variable power supply **141** capable of controlling a negative voltage, a second variable power supply **142** capable of controlling a positive voltage, a switch **143** that switches between the first variable power supply **141** and the second variable power supply **142**. The voltage applying device **107** determines the voltage for forming an electric field to be applied to the second transfer area TP2 according to the control signal from the control device **100** and applies the thus-determined voltage to the opposing roller **72** (**44**) via the power-supply roller **73**.

In this exemplary embodiment, electric fields to be applied to the second transfer area TP2 are as follows:

1. Second-Transfer Electric Field

The second-transfer electric field E2 is used to transfer (second transfer) the color component images, which have been transferred (first transfer) from the photosensitive members **31** of the image forming units **21***a* to **21***d* to the intermediate transfer body **22**, to the sheet **26**. The second-transfer electric field E2 acts in such a direction that the negative toner on the intermediate transfer body **22** is electrostatically transferred to the sheet **26**.

In order to form this second-transfer electric field E2, a negative voltage (bias) sufficient to move the toner on the intermediate transfer body **22** to the sheet **26** is applied to the opposing roller **72** via the power-supply roller **73**.

In this exemplary embodiment, as shown in, for example, FIG. **8**A, by increasing the absolute value of the negative voltage (bias) applied to the second transfer area TP2, the second transfer efficiency (i.e., the proportion of the amount of the toner image moved to the sheet in the amount of the toner image on the intermediate transfer body) reaches nearly 100% (for example, 98% or more). The range of the voltage (bias) with which the second transfer efficiency is nearly 100% is regarded as the allowable range for the second-transfer electric field E2, and a voltage (bias) within the allowable range is selected as the second transfer voltage (bias) B1.

2. Cleaning Electric Field

The cleaning electric field Ec reduces the charge record (i.e., the difference in amount of charge between the image portion and the non-image portion) remaining in the intermediate transfer body **22**. The cleaning electric field Ec is of the same polarity as and a lower intensity than the second-transfer electric field E2.

In this exemplary embodiment, as shown in, for example, FIG. **8**B, the relationship between the ghost grade and the voltage (bias) to be applied to the second transfer area TP2 is observed on the basis of, for example, a ghost evaluation method, which will be described in the following exemplary embodiment. The result shows that the ghost grade shows a peak, or the best result, near a voltage (bias) B2, which is lower than the second transfer bias B1, and the ghost grade gradually gets worse as the second transfer bias is farther from the value at the peak. Accordingly, in this exemplary embodiment, the voltage (bias) **32** is selected as the cleaning voltage (bias) for forming the cleaning electric field Ec.

In this exemplary embodiment, although a range in which the ghost grade is about 0.5 is used as the range for selecting the cleaning voltage (bias) B2, this range may be expanded to some extent, depending on the acceptable level of the ghost grade.

3. Holding Electric Field

The holding electric field Eh is needed when an image on the intermediate transfer body **22** passes through the second transfer area TP2 without the sheet **26** passing therethrough. The holding electric field Eh makes the image stay on the intermediate transfer body **22** without moving to the second transfer roller **71**.

In this exemplary embodiment, as shown in FIG. **8**C, the relationship between the amount of toner deposited on the second transfer roller **71** (in this exemplary embodiment, the amount of waste toner) and the voltage (bias) to be applied to the second transfer area TP2 is observed. When the voltage (bias) of the same polarity as the second transfer bias B1 is applied to the second transfer area TP2, the amount of waste toner decreases with the drop of the voltage. When the voltage comes to have opposite polarity to the second transfer bias B1, the amount of waste toner is further reduced, and at a predetermined voltage (bias) B3, the amount of waste toner is substantially **0**. Accordingly, in this exemplary embodiment, the voltage (bias) B3 is selected as a holding voltage (bias) for forming the holding electric field Eh.

Operation of Image Forming Apparatus

Next, the operation of the image forming apparatus according to this exemplary embodiment will be described.

Anti-Ghost Control Processing 1

FIG. **9** is a flowchart showing anti-ghost control processing 1 performed by the image forming apparatus according to this exemplary embodiment.

As shown in FIG. **4**, a user may select the image formation mode from an FC mode (full-color mode) and a single K mode (single color K mode) by operating the image formation mode switch **131**.

When the user selects the FC mode, the control device **100** determines that the image formation mode is the FC mode and selects an FC mode process. In this state, as shown in FIG. **6**A, the control device **100** selects the full contact mode for the retract mechanism **104**.

Then, the control device **100** adjusts first and second transfer conditions according to the FC mode.

On the other hand, when the user selects the single K mode, the control device **100** determines that the image formation mode is the single K mode and selects a single K mode process. In this state, as shown in FIG. **6**B, the control device **100** selects the partial contact mode for the retract mechanism **104** and adjusts the first and second transfer conditions according to the single K mode.

Image Transfer to Sheet

As shown in FIG. **9**, when the sheet **26** passes through the second transfer area TP2 (when the sheet **26** is fed), the second transfer bias B1 is applied to the second transfer area TP2, forming the second-transfer electric field E2 in the second transfer area TP2. As a result, as shown in FIG. **10**A, the image G on the intermediate transfer body **22** is transferred to the sheet **26** and is fixed thereto in the fixing device **27**.

When Toner Patch Passes

To control the image density and the image position, a rectangular toner patch G, serving as a process control image, is sometimes formed in an inter-image area S, in which the sheet **26** does not pass through the second transfer area TP2 (i.e., an area between the image areas of the sheets **26**).

This toner patch G passes through the second transfer area TP2 without the sheet **26** passing therethrough. In this exemplary embodiment, the electric field to be formed in the second transfer area TP2 is changed according to the image formation mode (FC mode or single K mode).

In this exemplary embodiment, as shown in FIG. **103**, when the FC mode is selected, the holding voltage (bias) B3 is applied to the second transfer area TP2, forming the holding electric field Eh in the second transfer area TP2. Thus, the toner patch G on the intermediate transfer body **22** passes through the second transfer area TP2 without moving to the second transfer roller **71** and becoming waste toner, and is cleaned by the cleaning device **47**. The charge record remaining in the intermediate transfer body **22** is gradually reduced as it passes through the first transfer areas TP1 of the photosensitive members **31** in the image forming units **21** corresponding to the respective color components.

On the other hand, as shown in FIG. **10**C, in the single K mode, the cleaning voltage (bias) B2 is applied to the second transfer area TP2, forming the cleaning electric field Eh in the second transfer area TP2. Thus, the toner patch G on the intermediate transfer body **22** is subjected to the cleaning electric field Ec when it passes through the second transfer area TP2.

At this time, as shown in FIG. **11**, the intermediate transfer body **22** is charged by the first-transfer electric fields E1 in the first transfer areas TP1 and is charged by the cleaning electric field Ec in the second transfer area TP2. When, for example, the second-transfer electric field E2 is formed in the second transfer area TP2, the toner patch G on the intermediate transfer body **22** having passed through the second transfer area TP2 has relatively large charge record m, which corresponds to the difference in amount of charge between the image portion and the non-image portion. On the other hand, when the cleaning electric field Ec is formed in the second transfer area TP2 instead of the second-transfer electric field E2, the charge record m shown in FIG. **11** is reduced. Hence, when the intermediate transfer body **22** having passed through the second transfer area TP2 passes through the first transfer area TP1 of the photosensitive member **31** of the image forming unit **21** (**21***d*) used for the subsequent image-forming job (for example, in the single K mode), the charge record m remaining in the intermediate transfer body **22** is sufficiently low. Accordingly, image quality defects due to charge record do not occur.

In this exemplary embodiment, either in the FC mode or in the single K mode, when the intermediate transfer body **22** carrying no image passes through the second transfer area TP2 without the sheet **26** passing therethrough, the cleaning electric field Ec or the holding electric field Eh is formed in the second transfer area TP2. However, an appropriate method may be selected.

Anti-Ghost Control Processing 2

In this exemplary embodiment, the electric field to be formed in the second transfer area TP2 is changed according to whether or not the image-quality priority mode is selected.

As shown in FIG. **4**, when the user turns on the image-quality-priority mode switch **132**, the control device **100** determines that the image-quality priority mode is selected, and when the image-quality-priority mode switch **132** stays off, the control device **100** determines that the image-quality priority mode is not selected.

Image Transfer to Sheet

As shown in FIG. **12**, when the sheet **26** passes through the second transfer area TP2 (when the sheet **26** is fed), the second transfer bias B1 is applied to the second transfer area TP2, forming the second-transfer electric field E2 in the second transfer area TP2. As shown in FIG. **10**A, the image G on the intermediate transfer body **22** is transferred to the sheet **26** and is fixed thereto in the fixing device **27**.

When Toner Patch Passes

In this exemplary embodiment, the toner patch G, serving as a process control image, may pass through the second transfer area TP2 without the sheet **26** passing therethrough. When the image-quality priority mode is selected, as shown in FIG. **12**, the cleaning bias B2 is applied to the second transfer area TP2, forming the cleaning electric field Ec. Hence, in the image-quality priority mode, when the toner patch G passes through the second transfer area TP2, the charge record is reduced, whereby image quality defects due to charge record are avoided.

On the other hand, when the image-quality priority mode is not selected, as shown in FIG. **12**, the holding bias **33** is applied to the second transfer area TP2, forming the holding electric field Eh. Thus, when the image-quality priority mode is not selected, image quality defects due to charge record may be observed to some extent. However, due to the effect of the holding electric field Eh, the risk of the waste toner moving to the second transfer roller **71** is reduced.

In this exemplary embodiment, when the intermediate transfer body **22** carrying no image passes through the second transfer area TP2 without the sheet **26** passing therethrough, the cleaning electric field Ec or the holding electric field Eh is formed in the second transfer area TP2. However, an appropriate method may be selected.

Anti-Ghost Control Processing 3

In this exemplary embodiment, the electric field to be formed in the second transfer area TP2 is changed according to whether or not the speed priority mode is selected.

As shown in FIG. **4**, when the user turns on the speed-priority mode switch **133**, the control device **100** determines that the speed priority mode is selected, and when speed-priority mode switch **133** stays off, the control device **100** determines that the speed priority mode is not selected.

Image Transfer to Sheet

As shown in FIG. **13**, when the sheet **26** passes through the second transfer area TP2 (when the sheet **26** is fed), the second transfer bias B1 is applied to the second transfer area TP2, forming the second-transfer electric field E2 in the second transfer area TP2. As shown in FIG. **10**A, the image G on the intermediate transfer body **22** is transferred to the sheet **26** and is fixed thereto in the fixing device **27**.

When Toner Patch Passes

In this exemplary embodiment, the toner patch G, serving as a process control image, may pass through the second transfer area TP2 without the sheet **26** passing therethrough. When the speed priority mode is selected, as shown in FIG. **13**, the cleaning bias B2 is applied to the second transfer area TP2, forming the cleaning electric field Ec. Hence, in the speed priority mode, when the toner patch G passes through the second transfer area TP2, the charge record is reduced, whereby image quality defects due to charge record are avoided.

On the other hand, when the speed priority mode is not selected, as shown in FIG. **13**, the holding bias B3 is applied to the second transfer area TP2, forming the holding electric field Eh. After that, the control device **100** causes the intermediate transfer body **20** to make one free revolution via the intermediate-transfer-body driving system **103** and applies the cleaning bias B2 to the second transfer area TP2 to form the cleaning electric field Ec in the second transfer area TP2.

Hence, when the speed priority mode is not selected, the risk of the waste toner moving to the second transfer roller **71** is reduced because of the effect of the holding electric field Eh. In addition, because the intermediate transfer body **22** is caused to make one free revolution while being uniformly charged, the charge record remaining in the intermediate transfer body **22**, if any, is gradually evened out while the intermediate transfer body **22** makes a free revolution, and the charge record is reduced. Accordingly, there is low risk of image quality defects due to charge record remaining in the intermediate transfer body **22** occurring in the subsequent image-forming job.

In this exemplary embodiment, when the intermediate transfer body **22** is caused to make a free revolution, the cleaning electric field Ec is formed in the second transfer area TP2. However, another electric field may be formed, or the first-transfer electric field E1 or a similar electric field may be formed in any one of the first transfer areas TP1. Furthermore, when the intermediate transfer body **22** carrying no image passes through the second transfer area TP2 without the sheet **26** passing therethrough, the cleaning electric field Ec or the holding electric field Eh is formed in the second transfer area TP2. However, an appropriate method may be selected.

Anti-Ghost Control Processing 4

In this exemplary embodiment, the frequency at which the toner patch passes through the second transfer area is predicted, and the electric field to be formed in the second transfer area TP2 is changed according to the predicted value.

As shown in FIG. **14**, the control device **100** predicts the patch frequency, i.e., the number of times the toner patch passes through the second transfer area in each job, and determines if the frequency is higher than a predetermined threshold.

Image Transfer to Sheet

As shown in FIG. **14**, when the sheet **26** passes through the second transfer area TP2 (when the sheet **26** is fed), the second transfer bias B1 is applied to the second transfer area TP2, forming the second-transfer electric field E2 in the second transfer area TP2. The image G on the intermediate transfer body **22** is transferred to the sheet **26** and is fixed thereto in the fixing device **27**.

When Toner Patch Passes

In this exemplary embodiment, the toner patch G, serving as a process control image, may pass through the second transfer area TP2 without the sheet **26** passing therethrough. When the patch frequency is high, as shown in FIG. **14**, the cleaning bias B2 is applied to the second transfer area TP2, forming the cleaning electric field Ec. Hence, in the speed priority mode, when the toner patch G passes through the second transfer area TP2, the charge record is reduced, whereby image quality defects due to charge record are avoided.

On the other hand, when the patch frequency is low, as shown in FIG. **14**, the holding bias B3 is applied to the second transfer area TP2, forming the holding electric field Eh. In this case, because the patch frequency is low, the charge record is not evident when the toner patch G passes through the second transfer area TP2. Thus, image quality defects due to the image record are not really a problem.

Comparative Example

FIG. **15** shows the relevant part of an image forming apparatus according to a comparative example.

The image forming apparatus shown in FIG. **15** is a tandem image forming apparatus of an intermediate transfer type and includes a static eliminating mechanism **200** disposed downstream of the second transfer area TP2, in the transporting direction of the intermediate transfer body **22**.

In this example, the static eliminating mechanism **200** includes a static eliminating roller **201** that is in contact with the outer surface of the intermediate transfer body **22**, and an opposing roller **202** provided adjacent to the inner surface of the intermediate transfer body **22** so as to face the static eliminating roller **201**. A static-eliminating power supply **203** that applies a static eliminating bias to the static eliminating roller **201** is connected to the static eliminating roller **201** to make the charge record remaining in the intermediate transfer body **22** having passed through the second transfer area TP2 have one polarity (in this example, negative). In FIG. **15**, the reference numeral **205** denotes a cleaning device for the intermediate transfer body **22**.

In this example, the static eliminating mechanism **200** reduces the charge record remaining in the intermediate transfer body **22**. However, the static eliminating mechanism **200** has to be disposed in a space between the second transfer device **25** and the cleaning device **205**, which increases the cost and makes it difficult to achieve a compact configuration. Moreover, maintenance of the static eliminating mechanism **200** is required.

EXAMPLE

First Example

This example is a tangible form of the image forming apparatus according to the first example, and the relationship between the volume resistivity of the intermediate transfer body and the ghost grade is studied.

The implementation conditions of this example are as follows:

<Use Environment>

Temperature/humidity: 22° C./55%

Print speed: 445 mm/s

Sheet: OS coat W127 gsm

<First Transfer Device>

First transfer roller: SUS shaft covered with a conductive rubber layer (rubber material: CO and ECO rubbers)

Outside diameter of roller: 24 [mm]

Diameter of roller shaft: 8 [mm]

Resistivity of roller: 6.6 [log Ω] when a voltage of 1000 V is applied

<Second Transfer Device>

Second transfer roller and opposing roller: SUS shaft covered with a conductive rubber layer (rubber material: CO and ECO rubbers)

Outside diameter of second transfer roller: 28 [mm]

Diameter of second transfer roller shaft: 15 [mm]

Resistivity of second transfer roller: 8.0 [log Ω] when a voltage of 1000 V is applied

Outside diameter of opposing roller: 20 [mm]

Diameter of opposing roller shaft: 14 [mm]

Resistivity of opposing roller: 6.4 [log Ω] when a voltage of 1500 V is applied

<Intermediate Transfer Body>

Polyimide seamless belt having a thickness of 100 μm, in which carbon black for adjusting resistivity is dispersed.

<Method of Measuring Resistivity of Intermediate Transfer Body>

A method in which a probe is connected to a measuring instrument, and a weight of 19.6 N is attached to the upper portion of the probe to apply a uniform load to belt pieces is employed.

Measuring instrument: Digital ultra-high resistance/micro current meter R8340A (manufactured by ADVANTEST CORPORATION)

Probe: UR probe MCP-HTP12 (DIA INSTRUMENTS CO., LTD.)

In this example, several intermediate transfer bodies having different volume resistivity are prepared, and the presence/absence of image quality defects due to charge record in these intermediate transfer bodies is checked and is evaluated as the ghost grade.

The result is shown in FIG. **16**.

FIG. **16** shows that image quality defects (ghost) due to charge record remaining in the intermediate transfer body occurs in the intermediate transfer bodies having a volume resistivity of 11 [log Ω·cm] or more. This may be because the intermediate transfer bodies having higher volume resistivity have more charge record remaining therein.

Ghost Evaluation Method

The ghost grade used in this example is evaluated on the basis of the ghost evaluation method shown in FIG. **17**.

FIG. **17**A shows a ghost chart.

This ghost chart shows several sets of vertical line images corresponding to three types of input density, Cin-I, Cin-II, and Cin-III (in this example, 40%, 70%, and 100%).

FIG. **17**B shows a ghost evaluation chart formed in an image-forming job subsequent to forming the ghost chart shown in FIG. **17**A.

In this ghost evaluation chart, halftone surface images corresponding to six types of input density, Cin-a, Cin-b, Cin-c, Cin-d, Cin-e, and Cin-f (in this example, 20%, 30%, 40%, 50%, 60%, and 70%), are arranged in the transverse direction orthogonal to the vertical line images.

The ghost grade is evaluated by observing which of the halftone surface images on the ghost evaluation chart, corresponding to the respective input densities, exhibits image quality defects (ghost) due to charge record of the line images on the ghost chart.

In the ghost evaluation chart in FIG. **17**B, image defects (ghost) are observed in the halftone images having high input densities (Cin-e and Cin-f).

Second Example

This example is a tangible form of the image forming apparatus according to the first example, and the relationship between the current supplied to the first transfer area and the surface potential of the intermediate transfer body, as well as the relationship between the voltage applied to the second transfer area and the surface potential of the intermediate transfer body, are studied.

In this example, although the first and second transfer devices are the same as those used in the first example, the intermediate transfer body has a volume resistivity of 13.6 (log Ω·cm).

The surface potential of the intermediate transfer body during driving is measured while the apparatus is operating, using a surface electrometer provided on the opposite side, at a position about 1 mm away from the intermediate transfer body, in a state in which the stretching roller **41** shown in, for example, FIG. **4** is grounded. The surface potential is measured using, for example, a surface electrometer MODEL 344, manufactured by TREK Japan KK.

The results are shown in FIGS. **18**A and **18**B.

FIG. **18**A shows the relationship between the current supplied to the first transfer area and the surface potential of the intermediate transfer body.

FIG. **18**A shows that, as the current supplied to the first transfer area is increased to 18 μA, 27 μA, and 54 μA, the surface potential of the intermediate transfer body gradually decreases.

FIG. **18**B shows the relationship between the voltage (bias) to be applied to the second transfer area and the surface potential of the intermediate transfer body.

FIG. **18**B shows that, as the absolute value of the voltage (bias) applied to the second transfer area is increased to −2 kV, −4 kV, −6 kV, the surface potential of the intermediate transfer body gradually increases.

Furthermore, in this example, the relationship between the current supplied to the first transfer area and the surface charge of the intermediate transfer body, as well as the relationship between the voltage applied to the second transfer area and the surface charge of the intermediate transfer body, are studied. Results are shown in FIGS. **19**A and **19**B.

FIG. **19**A shows the relationship between the current supplied to the first transfer area and the surface charge of the intermediate transfer body.

FIG. **19**A shows that, as the current supplied to the first transfer area is gradually increased to about 50 μA to 90 μA, the surface charge of the intermediate transfer body gradually decreases.

FIG. **193** shows the relationship between the voltage (bias) to be applied to the second transfer area and the surface potential of the intermediate transfer body.

FIG. **193** shows that, as the absolute value of the voltage (bias) applied to the second transfer area is increased to −4 kV, −5 kV, and −6 kV, the surface charge of the intermediate transfer body gradually increases.

These results show that the surface potential or surface charge of the intermediate transfer body may be changed by changing the current supplied to the first transfer area or the voltage applied to the second transfer area.

In this example, it is assumed that, by changing the voltage (bias) applied to the second transfer area, the electric field to be formed in the second transfer area is adjusted, contributing to a reduction in the charge, record remaining in the intermediate transfer body.

Third Example

This example is a tangible form of the image forming apparatus according to the first example. This example shows how to determine voltages (bias) applied to the second transfer area to form the second-transfer electric field, the cleaning electric field, and the holding electric field.

Implementation conditions of this example are the same as those in the second example.

Second Transfer Bias B1

FIG. **20** shows the relationship between the voltage (bias) to be applied to the second transfer area and the second transfer efficiency.

In FIG. **20**, the second transfer efficiency is the proportion (percentage) of the amount of image transferred to a sheet in the amount of image on the intermediate transfer body passing through the second transfer area. Because the image is formed with negative toner, a negative voltage (bias) is applied to the second transfer area, and the absolute value thereof is increased. At a voltage of just above −4 kV, the second transfer efficiency reaches nearly 100%.

In this example, a voltage (bias) that achieves substantially 100% second transfer efficiency is selected as the second transfer bias B1 to be applied to the second transfer area. In this example, the second transfer bias B1 is appropriately selected from a range of −4.5 kV to −5 kV.

Cleaning Bias B2

FIG. **21** shows the relationship between the voltage (bias) to be applied to the second transfer area and the ghost grade.

In this example, as shown in FIG. **22**, an image forming operation in the single K mode is performed under the conditions where the temperature is 21° C. and the humidity is 10% RH; the image forming units **21***a* to **21***c* are retracted via the retract mechanism; a toner patch having an input density Cin of 80% is formed using the image forming unit **21***d* corresponding to the black color component; and the toner patch G is allowed to pass through the second transfer area TP2 without the sheet passing therethrough.

During this image forming operation, the ghost grade is measured while varying the voltage (bias) to be applied to the second transfer area TP2.

FIG. **21** shows that the ghost grade shows a peak, or the best result, when a voltage (bias) of about −3 kV, which is lower than the second transfer bias B1, is applied to the second transfer area. The ghost grade gradually gets worse with a voltage (bias) that is either higher or lower than −3 kV.

In this example, a voltage (bias) that achieves good ghost grade, i.e., about −3 kV, is selected as the cleaning bias B2 to be applied to the second transfer area.

When the cleaning bias B2 is applied to the second transfer area, the cleaning electric field Ec is formed in the second transfer area, reducing the charge record remaining in the intermediate transfer body.

Holding Bias B3

FIG. **23** shows the relationship between the voltage (bias) to be applied to the second transfer area and the amount of waste toner on the second transfer roller.

As shown in FIG. **22**, in this example, the amount of waste toner moved to the second transfer roller **71** after the toner patch G passes through the second transfer area TP2 without the sheet **26** passing therethrough is measured, while varying the voltage (bias) applied to the second transfer area TP2. In FIG. **23**, the vertical axis shows the amount of waste toner moved to the second transfer roller **71** per 1000 sheets, when, in the FC mode, a single-color toner patch (inter-image patch) having an input density Cin of 100% and having a predetermined size (for example, 326×106.7 [mm^2]) is output between all the sheets.

In this example, when a negative voltage (bias) is applied to the second transfer area, negative toner is used. Thus, it is impossible to completely eliminate the waste toner moving to the second transfer roller **71**.

However, when a positive voltage (bias) is applied to the second transfer area TP2, little waste toner moves to the second transfer roller **71**, and in this example, at a voltage (bias) of about 2 kV, the amount of waste toner is substantially zero.

In this example, a voltage (bias) that achieves substantially zero waste toner on the second transfer roller, about +2 kV, is selected as the holding bias B3 to be applied to the second transfer area.

When the holding bias B3 is applied to the second transfer area, the holding electric field Eh acts in the second transfer area. Thus, the toner patch G passing through the second transfer area TP2 is securely held on the intermediate transfer body **22** and does not move to the second transfer roller **71** as waste toner.

The foregoing description of the exemplary embodiments of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obviously, many modifications and variations will be apparent to practitioners skilled in the art. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, thereby enabling others skilled in the art to understand the invention for various embodiments and with the various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

What is claimed is:

1. An image forming apparatus comprising:

a plurality of image carriers that carry images formed with color component toners;

an intermediate transfer body that is arranged to face the image carriers and is configured to run in a loop, the intermediate transfer body being brought into contact with at least one of the image carriers used for image forming to carry the image formed on the image carrier before transferring the image to a recording material;

a plurality of first transfer devices that include a plurality of first transfer members arranged to face an inner surface of the intermediate transfer body, at positions corresponding to the image carriers, the first transfer devices forming first-transfer electric fields in first transfer areas between the first transfer members and the image carriers to transfer the images carried on the image carriers to the intermediate transfer body;

a second transfer device that includes a second transfer member arranged to face an outer surface of the intermediate transfer body, the second transfer device forms a second-transfer electric field in a second transfer area between the second transfer member and the intermediate transfer body to transfer, to the recording material, the images transferred to the intermediate transfer body by the first transfer devices; and

an adjusting device that adjusts an electric field to be formed in the second transfer area to a cleaning electric field, which is of the same polarity as and a lower intensity than the second-transfer electric field, when the image transferred to the intermediate transfer body passes through the second transfer area without recording material passing therethrough.

2. The image forming apparatus according to claim **1**,

wherein the adjusting device selects a cleaning electric field such that a residual charge difference between an image portion and a non-image portion of the intermediate transfer body having passed through the second transfer area is less than or equal to a predetermined threshold.

3. The image forming apparatus according to claim **1**, further comprising:

a contacting/retracting mechanism that relatively brings the intermediate transfer body into contact with or retracted from the image carriers such that the intermediate transfer body is in contact with the image carrier used for image forming and such that the intermediate transfer body is not in contact with the image carriers that are not used for image forming; and

a contact-state selecting device that selects, using the contacting/retracting mechanism, a full contact mode, in which the intermediate transfer body is in contact with all the image carriers, or a partial contact mode, in which the intermediate transfer body is in contact with at least one, but not all, of the image carriers,

wherein, when the contact-state selecting device selects the partial contact mode, the adjusting device adjusts the electric field to be formed in the second transfer area to the cleaning electric field, and when the contact-state selecting device selects the full contact mode, the adjusting device adjusts the electric field to be formed in the second transfer area to a holding electric field, which is of opposite polarity to the second-transfer electric field.

4. The image forming apparatus according to claim 3,

wherein the image carrier located on a most upstream side, in the moving direction of the intermediate transfer body, forms an image with a less visible color component toner.

5. The image forming apparatus according to claim 3,

wherein the image carrier for forming a black toner image is located on a most downstream side in the moving direction of the intermediate transfer body and is in contact with the intermediate transfer body to be used to form an image, in either image forming state in which one image carrier is used or in which a plurality of image carriers are used.

6. The image forming apparatus according to claim 1, further comprising an image-quality selecting device that selects image-quality priority processing, in which the priority is given to the quality of the transferred image,

wherein, when the image-quality selecting device selects the image-quality priority processing, the adjusting device adjusts the electric field to be formed in the second transfer area to the cleaning electric field, and

wherein, when the image-quality selecting device does not select the image-quality priority processing, the adjusting device adjusts the electric field to be formed in the second transfer area to a holding electric field, which is of opposite polarity to the second-transfer electric field.

7. The image forming apparatus according to claim 1, further comprising a speed selecting device that selects, according to the type of the image to be formed, the speed of the image-forming processing performed on the image carriers and the intermediate transfer body during the image forming operation,

wherein, when the speed selecting device selects speed priority processing, in which an image forming operation is performed at a speed higher than a predetermined speed, the adjusting device adjusts the electric field to be formed in the second transfer area to the cleaning electric field, and

wherein, when the speed selecting device does not select the speed priority processing, the adjusting device adjusts the electric field to be formed in the second transfer area to a holding electric field, which is of opposite polarity to the second-transfer electric field.

8. The image forming apparatus according to claim 7, further comprising a driving control device that, when the speed selecting device does not select the speed priority processing, causes the adjusting device to form the holding electric field in the second transfer area and then causes the intermediate transfer body to make one free revolution while applying a predetermined electric field to the first transfer area or the second transfer area.

9. The image forming apparatus according to claim 1, further comprising a frequency prediction device that predicts the frequency at which the image transferred to the intermediate transfer body passes through the second transfer area without a recording material passing therethrough,

wherein, when the frequency predicted by the frequency prediction device is greater than or equal to a predetermined frequency, the adjusting device adjusts the electric field to be formed in the second transfer area to the cleaning electric field, and when the frequency predicted by the frequency prediction device less than the predetermined frequency, the adjusting device adjusts the electric field to be formed in the second transfer area to a holding electric field, which is of opposite polarity to the second-transfer electric field.

10. The image forming apparatus according to claim 1,

wherein, when the intermediate transfer body carrying no image passes through the second transfer area without a recording material passing therethrough, the adjusting device adjusts the electric field to be formed in the second transfer area to the cleaning electric field.

11. The image forming apparatus according to claim 3,

wherein the relationship $|B1-B3|>|B1-B2|$ is satisfied, where B1, B2, and B3 are voltages applied to form the second-transfer electric field, the cleaning electric field, and the holding electric field, respectively, in the second transfer area.

12. The image forming apparatus according to claim 1,

wherein the intermediate transfer body has a base member and a surface layer, the surface layer having higher surface resistivity than the base member.

13. The image forming apparatus according to claim 1,

wherein the second transfer device includes an electric-field forming device that forms the second-transfer electric field in the second transfer area, and

wherein the adjusting device serves a dual function as the electric-field forming device.

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